

*War is
Heaven*
The R&D Frontline

21•C

Industrial
Magic
Supercomputing

PREVIEWS OF A CHANGING WORLD

Toxic
Avenger
Green Auditing

RAISING HELL:
HAZEL HENDERSON'S
ECONOMIC CRUSADE

Investors
Wake!
Australian R&D

REVENGE OF THE NERDS:
SCIENTISTS STRIKE BACK!
1992: SPACE ODYSSEY

AUSTRALIAN
SCIENCE SAILS FOR
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INFORMATION TECHNOLOGY • BIOTECHNOLOGY
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FORD. THE FUTURE APPROACHES.

Today, Ford designers in Australia and overseas are using state of the art Computer Assisted Design techniques and advanced modelling procedures to design both cars and components for the next century. In the designs they're shaping anything is possible. Cars with sleek and beautiful bodies that contain breath-taking aerodynamic properties. While concealed beneath those shapely panels is automotive engineering at

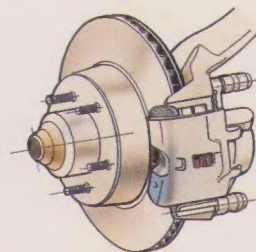
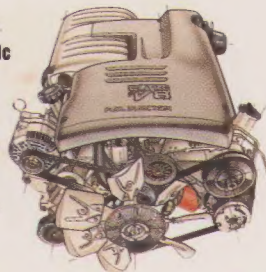


Ghia Via. Four door 2+2 sports coupe featuring computer controlled spoiler, fibre-optic lighting and psycho-ergonomically designed interior to comfort all the senses.

the cutting edge of technology. And whilst Ford in Australia can call on technical resources from around the world, it's proud of the advances it is making locally. Such as our involvement in the design, development and construction

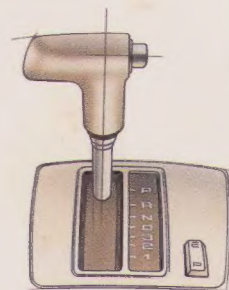
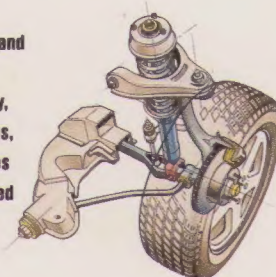
of a four-speed electronically controlled automatic transmission now available on the EB Falcon, Fairlane and LTD range. The future arrives one day at a time. So automotive advancement is a process of evolution rather than revolution. Already refinements such as those illustrated here are finding their way into the Ford range. And future technologies Ford in Australia is exploring, include engines that use alternative fuels and produce ecologically low-impact emissions. Not everything Ford designs makes it onto the showroom floor. But everything Ford does, goes towards building better cars for the future. The promise of tomorrow is one of enormous potential. And in driving technology into new and exciting areas; it's a promise Ford is already delivering.

V8 engine with Sequential Multipoint electronic fuel injection and the EEC 4 engine management system that monitors and controls the engine's vital functions for optimum performance and efficiency.



Anti Lock Braking. A computer-controlled load and speed sensitive system designed to provide maximum control and safety under even the most extreme braking conditions.

Advanced steering and suspension with optimised geometry, rigid rack mountings, polyurethane bushes and nitrogen-charged gas pressurised shock absorbers.



Four-speed electronically controlled automatic transmission with lock up torque converter and power and economy modes. Incredible smoothness and quietness of operation.



HAVE YOU DRIVEN A FORD...LATELY?

FCL851

Meeting the major challenge of 21c - Feeding the world

■ A quarter of a million people are born into the world every day. The world's population now stands at 5.3 billion and is projected to reach anywhere between 10 and 14 billion by the end of the next century. The problem of feeding this huge population without destroying the environment is the major challenge of the 21st Century.

Food production is already the activity with the greatest environmental impact globally. How then do we feed more people and avoid increasing the impact of agriculture on the world's environment?

The key is to make better use of what we have. Population growth is not, of itself, the source of food shortages; rather poverty and the failure to distribute the world's food supplies equitably is the real culprit. In Africa millions starve from the effects of drought, while in the tropics there is water in abundance. In Russia official estimates say 80%

of food produced can be lost before it reaches the consumer.

There are many, mainly political reasons for this waste and for the suffering caused by it, but one of the most immediate causes is a lack of efficient packaging.

The key to feeding a larger world population may not be in producing more food, but making sure that the food that is produced gets to the consumer - reducing food wastage and wastage of the environmental impact associated with its production. Environmentally efficient packaging can and is helping to reduce this wastage and in the forefront of this effort is a new kind of packaging technology - U.H.T. or "Long life" packaging.

'Long life' packaging has revolutionised the distribution of major foods such as milk, fruit juice, even water in first and third world nations.



More packaging = Less waste in 21c

■ The history of packaging has shown it as a powerful tool for minimising waste - particularly wastage of our most precious resources, food and land - resources that have traditionally been the cause of wars.

One of the stark differences that exists between developed and under-developed countries is their use of packaging to minimise the loss of food during distribution - food that has been grown or produced at significant cost to the environment. Losses of the scale reported in some areas up to 80% would require a trebling of agricultural production to compensate, that is a trebling of the environmental impact of producing this food - unless we make

better use of the food already produced. If food wastage were to be eliminated through better packaging and distribution only a half to a third of the world's land currently used to produce food would be needed - or alternatively the land currently used for food production could feed two to three times the number of people.

Mexicans are poorer than Americans and use much less packaging. A study of what each community throws out shows Mexicans produce 43% more waste per capita than Americans do, much of it food related waste. The trend to reduce the waste of food through improved packaging and distribution will increase in the 21c.

DID YOU KNOW?

That in some of the poorest countries between 50% and 80% of food produced never reaches the consumer? It is wasted along the way through lack of an efficient distribution system.



DID YOU KNOW?

Kenya features a "long life" carton on one of its bank notes in recognition of its role in essential food distribution giving Kenyan children access to milk.

DID YOU KNOW?

That until "long life" packaging was introduced into Southern Italy in recent years there was very little milk available there. There was plenty of milk in Northern Italy - just no way of getting it to the South.

What is this minor technological miracle?

■ The technology is actually the marriage of a process and a package. The U.H.T. or aseptic process rapidly kills the bacteria that can cause food spoilage and the "long life" pack preserves the treated food without the need for refrigeration or preservatives.

DID YOU KNOW?

The United Nations uses "long life" packaging to distribute a salt and sugar solution to combat dehydration in starving children in Africa. The pack ensures the solution is sterile. It takes up little space and can be burnt for energy after use.

The "U.H.T." Process

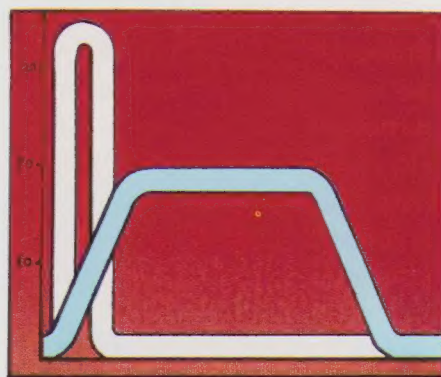
■ U.H.T. stands for "Ultra Heat Treated" and, in spite of what it sounds like the process actually exposes foods to much less heat than pasteurisation, canning or even cooking.

How is this done? The food to be treated is simply heated very quickly to around 140°C held there for two to four seconds and just as rapidly cooled. The whole process only takes a few seconds as opposed to many minutes of high temperature as in the pasteurisation of milk, or hours of cooking as occurs in the food canning process. The result is that any food that is U.H.T.

treated retains more of its vitamins and other nutrients and more of its flavour and aroma compounds than food preserved by other methods.

So we see that food so treated does not spend enough time at elevated temperatures - for a reduction in vitamins or nutrient content to occur - however the bacteria responsible for food spoilage are completely killed.

The U.H.T. or aseptic process enables food to be packed in sterile conditions, eliminating the need for chemical additives, preservatives or refrigeration.



What is so special about the "Long Life" package?

■ Having made the food bacteria free the challenge now is to keep it that way, using a pack that has minimal environmental impact.

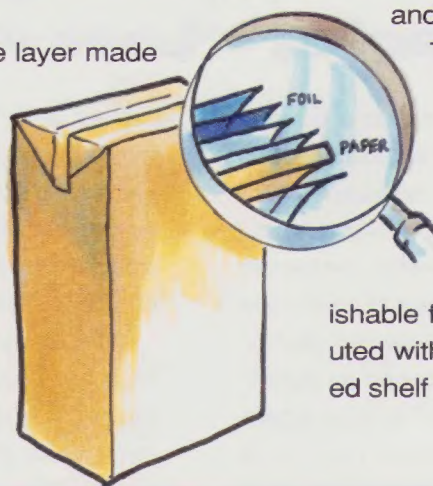
An aseptic or "long life" carton has a core layer made of paperboard, ultra thin layers of polyethylene to make it liquid proof and prevent the migration of moulds and bacteria and a superfine layer of aluminium keeps out air or more particularly, oxygen - the other potential spoiler of food.

This multi-layer approach to packaging design ensures the minimum quantities of resources are used to provide the consumer with a package that

meets all of the functional requirements of rigidity and strength whilst providing barriers to moisture, oxygen and re-infection by external microorganisms.

The net result of the combining the "UHT" process and the "long life" package is fresher, purer food made available in a safer more convenient and environmentally acceptable package without loss of nutrients or flavour.

The long life package also enables perishable foods to be packaged, stored and distributed without refrigeration whilst providing extended shelf life.

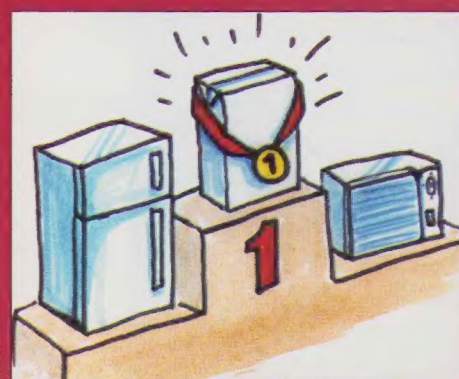


Award winning technology

■ The "long life" carton, has been awarded the prestigious Institute of Food Technologies' award as the top food science innovation in the last 50 years, ahead of innovations such as microwave cooking and freeze drying.

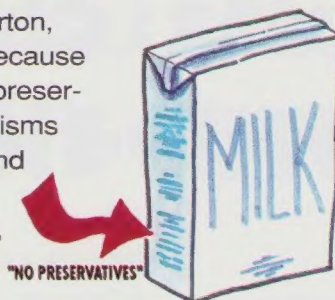
"Long life" packaging was given top honours because of its outstanding ability to protect and preserve nutrients in foods, particularly vitamins that are so easily destroyed by other processes, whilst at the same time ensuring maximum flavour and safety.

"Long Life" packaging as an invention is rated as highly as the invention of refrigeration in its ability to assist in the huge task of distributing food to the world.



Meeting 21c consumer needs

■ More consumers now check the label of food packs to see which preservatives, if any, the food contains. If you check the label of a "Long life" carton, you won't see any preservatives mentioned because "UHT" or "long life" packaging does not need preservatives, having killed food spoiling microorganisms by the short burst of heat prior to packaging and designed the carton to keep others out - the food needs no other means of preservation, no refrigeration - no preservatives.



"Long life" packaging also meets consumer expectations relating to freshness and flavour. People like to think that the food they eat is as close to nature as possible - preferably unprocessed - so that all the nutritional value or 'goodness' of the food is retained. "Long life" packaged food keeps this promise as the only processing it is likely to have had is those few seconds of heat treatment.

What is being packed the "Long Life" way and what will we see by 21c

■ Most Australians are familiar with the 1 litre size "Long life" packs for milk and orange juice. Also popular are the smaller "lunch box" size packs. Australian mums pack millions of them in children's lunch boxes each week.

Soup stock, flavoured milks, tomato paste, custards and soy drinks are also available in "long life" packaging.

In Europe, soups, sauces, wines, deserts, and mineral water are also

packed this way and recently one of Europe's largest packers of vegetables has moved across from cans to the "Long life" pack. Packaging technologists see "Long life" packaging taking over from older ways of preserving food, like bottling and canning operations, because long life packaging delivers a fresher more flavoursome product whilst using fewer materials and energy resources.



What else will the 21c consumer look for?

■ The 21C consumer will be looking for packaging to match a more active mobile lifestyle. More and more meals will be consumed outside the home by people on the move. Long life packaging fits right into the lifestyle as it is compact, light weight, easy to use and safe.

21C consumers will be more environmentally aware and ask packaging to meet strict environmental criteria - especially those that relate to resource use efficiency.

"Long life" packaging is designed to meeting those objectives - it saves the environment more than it costs - it is a waste saving package.



DID YOU KNOW?

Between 1912 and 1937 there were 65,000 deaths in England attributable to infection from raw milk. Between 1951 and 1980 there were just 4. Effective packaging was greatly responsible for the substantial reduction.

DID YOU KNOW?

A litre of orange juice leaves behind at the factory between 1.2 kg of peel and rind which is reprocessed into feed and fertiliser. Weighing only 28g an orange juice carton saves over 40 times its own weight in waste. If 400 million litres of orange juice was all packed in cartons nearly 500,000 tonnes of waste would be saved through the use of 11,200 tonnes of packaging.

The need to protect food from light damage

■ People have long recognised that microbes, heat and air are enemies of food freshness, and food needs to be protected from these to retain its flavour and nutrient value.

Less recognised is the need to protect food from light damage. Understanding the potential impact of light on food is becoming more important as packaged foods are now displayed in brightly lit areas for hours to days prior to sale.

Research on the effects of light on milk took place as early as 1889 when

German scientists discovered that milk underwent changes to freshness and flavour when exposed to even low doses of light. We also know that many of the natural vitamins in foods are light sensitive. Modern research on the impact of light on milk and a range of other products shows that even relatively short periods of exposure to light can reduce the food's vitamin content.

"Long life" cartons screen out all harmful light and ensure that the food's natural goodness is retained.



Looking after the environment in 21c

■ 21c consumers will expect packaging to deliver its benefits of distributing cleaner, healthier, more nutritious and preservative free food with minimal impact on the environment. The long-life carton is up to this task.

CARTONS - ENVIRONMENTAL BENEFITS:

LIGHT WEIGHT

■ If a litre of milk or orange juice is packed in a long life carton less than 3% of the weight transported is packaging - 97% is the food itself - light weight long-life cartons, save energy in transport and the pollution associated with transport.



NO REFRIGERATION SAVES OZONE IMPACT -

■ Refrigeration is one area where CFC's are still being used and there is much discussion about the high cost of replacing current refrigeration technology with more ozone friendly technology. One way to eliminate the need for CFC's in refrigeration is to eliminate the need for refrigeration itself. The long life carton needs no refrigeration, before it is open, not only saving energy but the ozone impact associated with refrigeration.



LESS WASTE

■ 'Long life' cartons are light in weight and therefore produce less waste, per volume packed. The average Australian family's yearly milk consumption would need 100kg of one-way glass packaging but just 7kg of carton packaging. If that family drank all its milk from cartons it would take 10 years to fill one large "wheely bin" with squashed cartons.



RECYCLABLE

■ 'Long-life' cartons can be and are being recycled. They can be reprocessed to recover fibre for paper production or shredded and compressed into building board. Some countries compost carton material along with other household waste to produce fertiliser or potting mix. Others recycle them by burning them to recover energy. A one litre carton can produce enough energy to light a 60 watt globe for one hour.



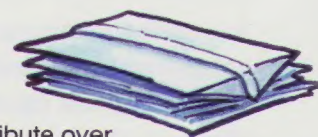
RENEWABLE RESOURCES

■ The heart of a long life carton is its paper core which makes up more than 80% of its weight. The paper is made from the waste products of the forestry industry which produces saw logs for furniture and housing. Timber used comes from plantation forests which are sustainably managed. Cartons are largely made from a renewable resource. For every tree harvested many more are planted.



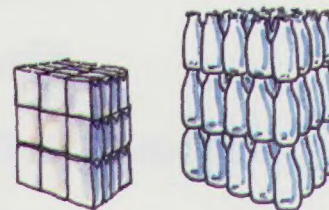
SAFE TO DISPOSE OF

■ 'Long-life' cartons flatten for easy disposal taking up little space in landfill. Cartons are non-hazardous and stable in landfill. Cartons for milk and juice distribute over 1 billion litres a year of those foods yet carton waste makes up less than 0.25% of waste currently going to landfill. Carton recycling programs are being introduced across Australia.



COMPACT

■ The 'long life' carton's shape means it is "cube efficient" and takes up a lot less space on a truck than conventional packages, saving on the number of trucks needed to move the same volume of food.



DID YOU KNOW?

Only 15% of the world's harvested wood supply is used to produce pulp and paper. Most commercially harvested timber is used to produce sawlogs for furniture and housing.

Timber harvested from these managed forests is replaced with new trees.

So what does "U.H.T" or 'Long Life' mean to you?

■ If you pick up a carton labelled "U.H.T." or "Long Life", it means the food inside has been minimally treated to destroy food spoiling bacteria but retains its vitamins, nutrients and flavour. It also means you are choosing to buy your food in a pack that has a minimum impact on the environment one that saves the environment more than it costs to make.



For more information about U.H.T. or "Long Life" packaging, please contact:
ALC, PO Box 2572, North Parramatta, NSW, 2151.

"LISTEN TO THE FUTURE."

If you listen to tired old commercial radio stations your ears are well and truly behind the times.

Because only TRIPLE J plays new music first right around Australia.

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International acts like Midnight Oil and INXS first got their start with us.

While new bands like Ratcat, Yothu Yindi and EMF (*and the rest*) would still be playing weddings, parties (*anything*) without our support.

And when you listen to us first you'll be months ahead of everyone else.

Why you'll even end up ahead of yourself.



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PERTH 99.3FM

CANBERRA 101.5FM

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MINDING OUR OWN BUSINESSES

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Publisher: Susan Oliver

Editor: Ashley Crawford

Sub-Editor: Ray Edgar

Design: Terence Hogan

NEXT: Ian Robertson

Contributing Editors:

Rick Slaughter McKenzie Wark

Business Manager: Gib Wettenhall

Advertising: David Fallick

Telephone: 613 576 1275

Separations: Hi-Tech Graphics

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Managing Director: Susan Oliver

Chairman: Robyn Williams

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An historic handshake: on July 17, 1975, U.S. astronauts and Soviet cosmonauts shake hands while in orbit. '21•C' salutes the International Year of Space on pages 66-69. Illustration published in 'NASA: Visions of Space' (1990)

Creating the Future

21•C arrives in Singapore! This edition of *21•C* is the official magazine for Australia's presence at the ASEAN Science and Technology conference in Singapore from September 17-24.

In keeping with the event, *21•C* looks at the research and development of science and technology in Australia and its potential to 'crack' the Asian market. At the same time we reflect on a European review recommending major changes for the European Commission's billion dollar scientific research and development programs.

As popular opinion of science lurches from 'technofear' to 'techno-optimism'; when scientists are on the one hand seen as the perpetrators of crimes against society, conspiring with industry, and on the other hand as the critical force of change towards a sustainable future, *21•C* explores scientific achievement and contemplates the cultural image of the scientist and wonders if scientists really are 'nerds'.

21•C also engages three of Australia's business leaders in some serious thinking about the future and what really matters to them. In contrast, we allow economics futurist Hazel Henderson to chop away at the foundations of modern economics.

I trust you find this issue of *21•C* an informative read and a celebration of the breadth of Australia's endeavours in the fields of science and technology.

In the last edition of *21•C* we enclosed a reader survey. The response was overwhelming and a healthy mix of compliments and criticisms flowed in. Most readers enjoyed the mix of editorial features in *21•C*, however, there was also a considerable percentage with strong criticisms of the magazine's size and price.

The survey has allowed us to focus on the positive and the negative aspects of *21•C* as you, the reader, see them. We are accordingly exploring avenues to improve the publication towards that wished for by its audience. Expect some exciting changes in the near future.

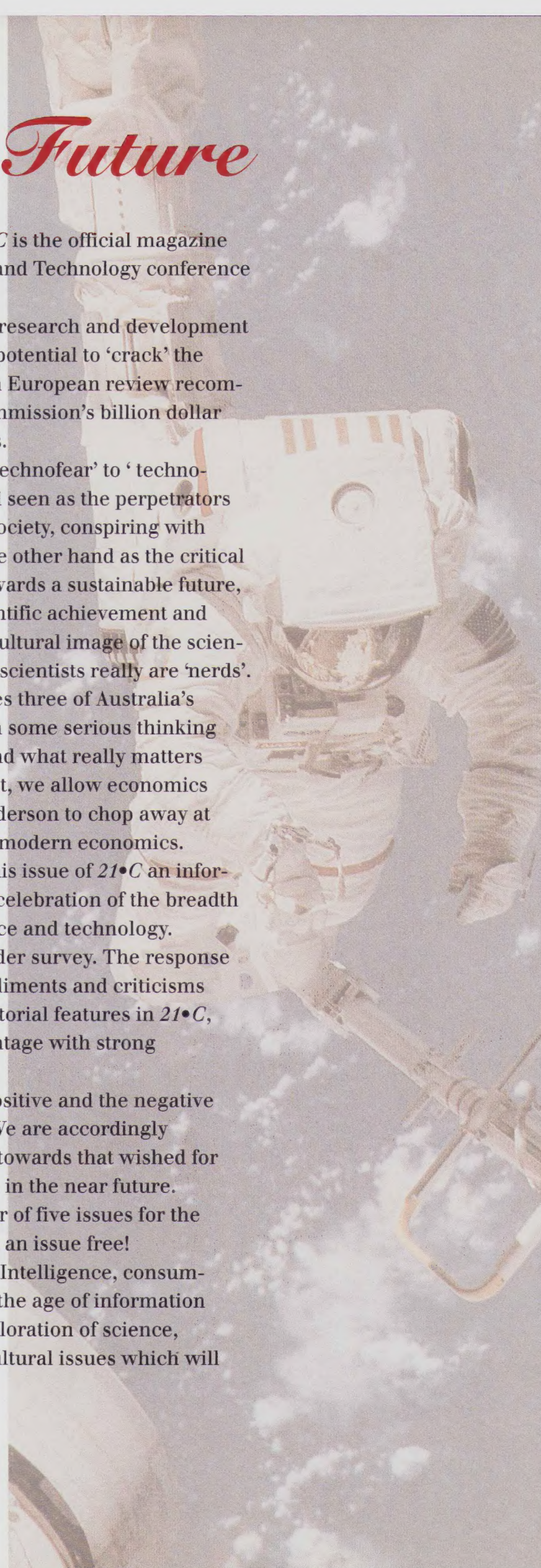
We are also continuing our subscription offer of five issues for the price of four. Subscribe now and you'll receive an issue free!

Next issue we explore the world of Artificial Intelligence, consumerism and what shape advertising will take in the age of information technology. And as usual, we continue our exploration of science, technology, environment and the social and cultural issues which will shape our planet and society in the future.

SUSAN OLIVER
Managing Director



Susan Oliver
Managing Director, The Australian
Commission for the Future.



LETTERS

Dear Editor,

In his recent article on Australia's population growth (21•C Autumn 1992), Gib Wettenhall makes a number of assertions which he fails to substantiate.

He claims that environmentalists who support a smaller immigration program ("green limitationists") regard population growth as the sole cause of environmental degradation. This is simply not true. Most greens concerned about Australia's rapid population growth believe that environmental impact is determined by the factors: population size, *per capita* consumption and the technologies used by society. Most green limitationists support reducing wasteful levels of consumption in Australia and the adoption of more appropriate technologies *as well as* stabilising our population as soon as possible. This distinguishes them from those who support all environment reforms as long as the immigration program is not reduced. Population is just too touchy a subject for some people.

Mr Wettenhall states that continued population growth in Australia will not contribute to the depletion of resources. He draws on the argument of Dr Ruth Fincher, a researcher sponsored by the notoriously pro-immigration Bureau of Immigration Research, to reassure us that substitutes for most scarce resources can be found if proper management strategies are applied. What about the resources of soils, forests, clean drinking water, unpolluted rivers and vanishing native species?

Drawing further on the writings of Dr Fincher, Mr Wettenhall cites her argument that "most change is generally the product of political or management decision-making – factors which are both difficult to predict and largely ignored by the limitationists". The sort of change which Dr Fincher and her managerialist BIR colleagues have in mind here is that fostered by the imposition of higher water charges to discourage consumption. This is a policy which is resulting in poor people in my home city Adelaide allowing their gardens to die in summer. Of course, this can hardly be said to be improving the quality of life of these residents. This well demonstrates the

point that limitationists are trying to make. Continued population growth stretches our natural resources and underfunded capital infrastructure and contributes to rising costs and declining quality of life.

Mr Wettenhall suggests that: "One could argue that Australian aspirations to owning a home and driving a car hold more implications for teaching sustainable development than halving the immigration intake". Many environmentalists and government advisers would like to see Australians living like Europeans in 6-storey rented flats. This way we could pack more humans into our city spaces. But why should Australians be deprived of home ownership, a cherished community tradition?

Mr Wettenhall cites with approval a case study which purported to show that declining indigenous populations in developing countries led to a breakdown in resource management. Presumably he is not seriously suggesting that a "clever country" future for Australia could be a return to indigenous agricultural systems.

Finally, in response to Mr Wettenhall's suggestion that Australians for an Ecologically Sustainable Population "cannot be neatly categorised as a right wing group of racists" may easily leave a reader with the feeling that AESP may perhaps be messily categorised as right wing and racist. AESP is committed to a non-racially selective immigration policy.

EVONNE MOORE

Australians for an Ecologically Sustainable Population

Gib Wettenhall replies:

Linking an ecologically sustainable future with calls to halve Australia's immigration intake would seem a particularly malodorous red herring.

Australia's population levels are not the primary factor behind environmental degradation in this country. Adelaide's reservoir system for instance faces an appalling future largely as a result of salinity levels in the Murray and the spread of toxic blue-green algae – both products of poor farming practices.

In the Australian situation, it's not the numbers that count, it's the way they behave.

Dear Editor,

Allow me to start by thanking you for the first class publication, 21•C. This journal first sought my attention with issue two at a municipal library.

Since then I've purchased my own copies, read them from cover to cover, and enjoyed well formulated articles encompassing political, environmental and technological issues.

Best of all 21•C directs its articles at the general public, schools, scientists and myself (a registered nurse). Providing us with current events while we marvel at scientific fact outstripping fiction. The entire sum of which is presented with the most enjoyable layout.

Keep amazing and informing.

MICHAEL P MCGIBBON

Dear Editor,

Our library will open a subscription to 21•C; there is so much of topical discussion in it, handled so rationally, that we can't NOT place it before our people.

I found Phillip Adams' interview with Germaine Greer absorbing.

BEV PORTEOUS

Librarian

Dear Editor,

Since 21•C began I have found the interviews you conduct to be one of the most interesting parts of your magazine. They provide a fascinating perspective on what people who have been deeply involved in helping create our future see as being important for that future.

My suggestion is that 21•C enhance this process by soliciting involvement by a far wider range of people to act as interviewers. For example, two people from outback Australia could interview Barry Jones on equity in decision making and representation in the political process. Or a group of high school students could discuss changing attitudes to discrimination with Dale Spender.

Many other variants on these ideas could no doubt be suggested, each geared to provide a challenging and perception changing article for the readers of 21•C.

I imagine that many of your readers (including myself) would be interested in ideas such as these and hope that a trial may soon be made. If successful the trial could foreshadow a more interactive 21•C offering a wider perspective on our changing world. I look forward to your response to this suggestion.

MICHAEL NIELSEN

.....
Letters to the editor should be addressed to The Editor, 21•C, PO Box 115 Carlton South, 3053. Due to limitations of space, letters over 250 words will be edited.

IF YOU COULD ONLY HAVE ONE CAR IN THE

Would it be a weekday limousine? Would it be a weekend wagon? Or would it be a holiday 4WD?

The ideal situation would be to have one car with the features of all three. Somewhat like Range Rover.

We venture to suggest that Range Rover is not only an exceptional vehicle, it is the exception to all other vehicles in the world.

The vehicle that finally bridged the gap between practicality and pleasure; a concept since copied by many, but matched by none.

That's why you'll chance to see a Range Rover outside any of our best five star hotels, yet parked under a million stars on the sands of Fraser Island.

Range Rover gets taken to Her Majesty's one night, then to the snowfields the next. And there are not many cars which can accommodate evening dress and après ski without feeling remotely out of place.

Range Rover has been hailed as the world's finest four-wheel drive vehicle. And one of Europe's best-ever designs (That's why it has been exhibited in the Louvre, Paris.)

Being functional as well as beautiful it comes packed with the power of an all-alloy V8 with electronic fuel injection for massive torque with moderate fuel consumption. This is one reason Range Rovers are so popular for towing.

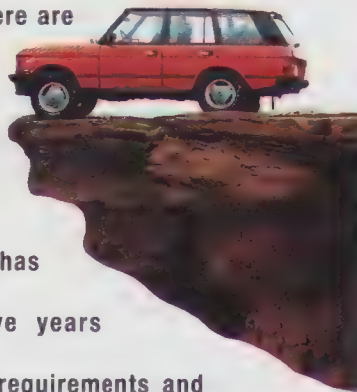
Another is the self-levelling rear suspension, which gives a constant ride-height no matter what load is carried or pulled.

Permanent four-wheel drive (and anti-roll bars on the Vogue and SE) models give the sort of precise,

accurate handling you would expect from a well-bred European sports saloon.

Of course, how a vehicle stops is just as important as how it goes, so there are large disc brakes all round, with ABS standard on the SE model.

This ABS system has been developed over five years for Range Rover's unique requirements and is capable of reacting 2.5 times faster than those of some of our competitors.



For your nearest dealer, look in the "Motor Cars" section of your local yellow pages, or call Sydney 685 5126, outside Sydney 008 221 078 (free call) or fax (02) 687 2266. 1992 Range Rovers

WORLD.

Range Rover has always been as at home in the Australian outback as it is on the German autobahn.

Off the beaten track you'll appreciate the incredibly strong box-section chassis and long-coil suspension which keeps the wheels firmly planted on the ground for maximum traction under the most punishing conditions.

The Viscous Coupling Unit automatically locks the centre differential the instant any loss of traction is detected, so there's no need to stop to engage diff-lock.

No matter how far you drive, rust is something that happens to other people's cars, because Range Rover has body panels made from aluminium.

means a considerable weight saving and a very low centre of gravity which increases stability on and off the road.

The body is rubber-mounted onto the chassis to absorb noise and vibration, and with less weight to suspend, softer springs can be used, creating the legendary Range Rover ride comfort.

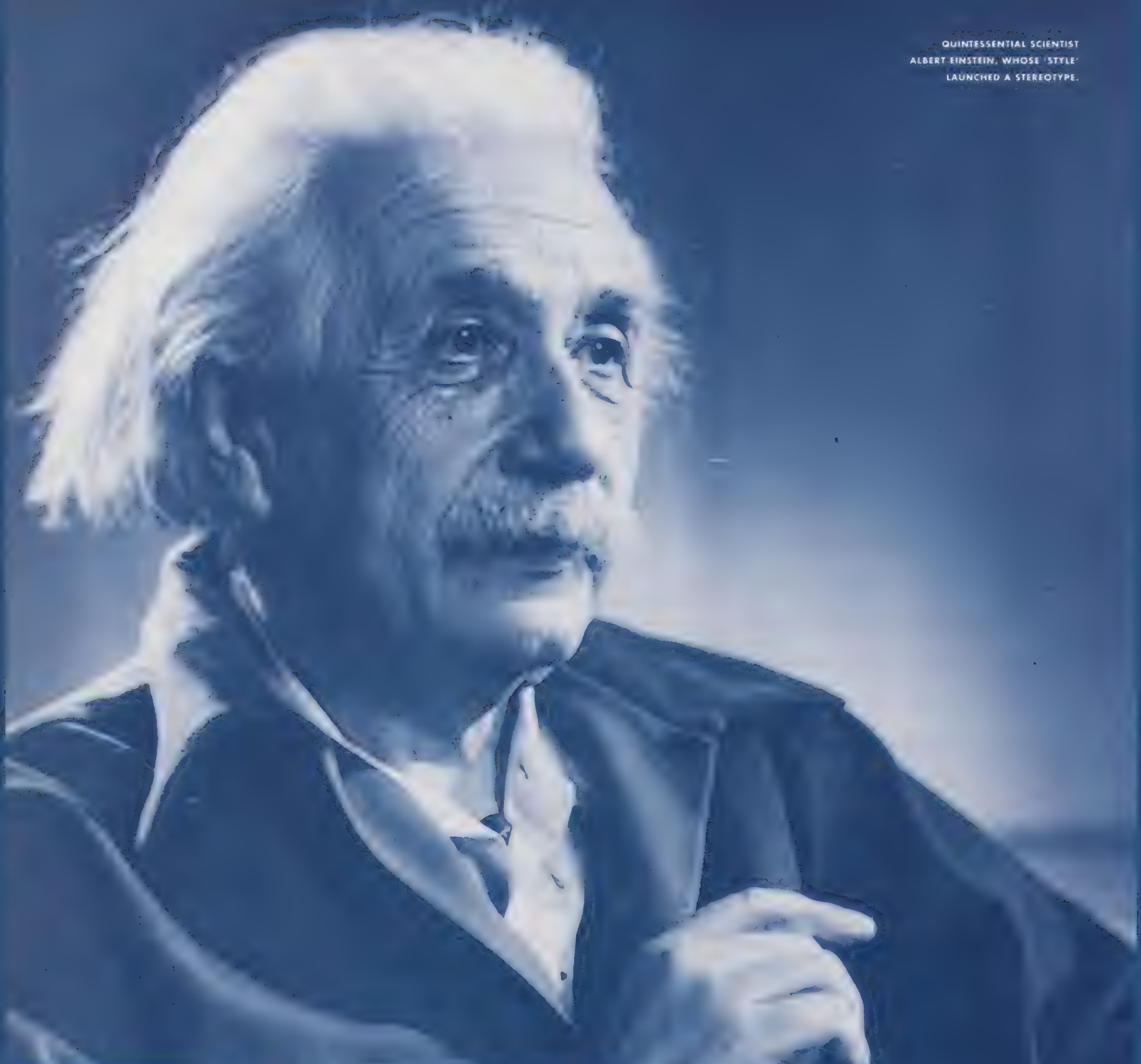
And speaking of comfort, the Vogue SE boasts such luxury features as Connolly hide upholstery, electrically-operated seats with two-position memory, glass sunroof, cruise control, ten-disc CD player, burled walnut panelling and an automatically-dipping rear view mirror.

For so many people there is only one car in the world. And in the 1990s who needs

Besides being rustproof, this **RANGE ROVER** more than one of anything?



DMB&B/WEEKES MORRIS OSBORN WRO 1628




QUINTESSENTIAL SCIENTIST
ALBERT EINSTEIN, WHOSE 'STYLE'
LAUNCHED A STEREOTYPE.

ANDREA HORVATH REPORTS

Revenge

Why is it that scientists rarely frequent magazine covers? Despite the media stereotype of the scientist as 'nerd', inside the scientific community very few scientists actually fit the



QUINTESSENTIAL 'NERD' JERRY LEWIS
(SEEN HERE WITH CO-STAR STELLA STEVENS)
CONSOLIDATES THE MYTH IN
THE NUTTY PROFESSOR.

of the Nerds'

model, nor do they deserve it. So where does the 'nerd' image come from and what effect does this mythical stereotype of scientists have on the general public's perception of science?

Variations of the science 'nerd' appear in kids cartoons, advertising laundry detergents, breakfast cereals or demonstrating the efficiency of a refrigerator and, of course, in the spectrum of Hollywood productions.

The image of a scientist to many in the general public is an elder male, either balding or with wild grey hair in a white coat with glasses (Albert Einstein being the classic example). 'He' is often perceived working alone on something secret or destructive. Other personality traits include absent mindedness or madness which tends to exclude 'him' from dinner party lists. The modern scientist is often depicted as wearing daggy glasses, unfashionable clothes and is glued to a computer with a pocket protector full of pens. In other words a 'mega nerd'.

Variations of the science 'nerd' appear in kids cartoons, advertising laundry detergents, breakfast cereals or demonstrating the efficiency of a refrigerator and, of course, in the spectrum of Hollywood productions.

It is little wonder that the image has become entrenched in the subconscious. When commonsense prevails and declares that a stereotype is just a stereotype, this image of a scientist is quickly shattered. Perhaps the best examples of this are the youthful female *cafe latte* drinking trendy scientists. There is the occasional 'classic nerd' wandering around university departments, but they are just as common in the non-scientific community.



ABOVE AND LEFT:
JEFF GOLDBLUM AS OBSESSED
SCIENTIST SETH BRUNDLE IN
DAVID CRONENBERG'S *THE FLY*.



LEFT: HARDLY
YOUR 'NERD' SCIENTIST,
HARRISON FORD AS
'THE COOLEST OF
ARCHAEOLOGISTS',
INDIANA JONES.
BELOW: FORD, IN
UNSCIENTIFIC MOOD,
WITH ALISON DOODY.
INDIANA JONES AND
THE LAST CRUSADE.



After all, every family has one, and every office has one too. (The nerd in *Ghostbusters* is an accountant.)

The origin of this scientific stereotype has been the focus of research of people like Roslynn Haynes, a lecturer at the University of NSW. She finds that the stereotype can be categorised into variations on the 'nerd' theme including the evil alchemist such as Drs. Frankenstein and Faust, reckless villains, destroyers, heroic adventurers and world saviours – as seen in 1950s utopian American sci-fi cinema.

Then there is the emotionally deficient type like Dr Spock (*Star Trek*) or even 'HAL' (*2001: A Space Odyssey*), or a more recent version, Ash, the cold company android in Ridley Scott's *Alien*.

And how could we overlook the absent minded professor, the silly scientist so ably portrayed by Jerry Lewis in the *The Nutty Professor*, or the eccentricities of the long running British television hero *Dr Who*?

In Robert Louis Stevenson's *The Strange Case of Dr Jekyll and Mr Hyde* we find another image; the scientist that is unable to control his discovery, an image used again, most powerfully in David Cronenberg's remake of *The Fly* where scientist Seth Brundle, gradually transforming into a sickening version of a giant fly, muses with black humour as to whether he will be the first "insect to win the Nobel Prize".

Then of course there is the kindly Vincent Price in *Edward Scissorhands* who dies, leaving his invention incomplete and having to fend for itself. Few of these images, although entertaining, are very appealing.

However the 'nerd' comes from the accumulation of centuries of literary portrayals of various scientific characters. Novels, books, and plays that feed into common culture and influence and formulate attitudes in society of scientists and therefore science. Alternatively, literature can act as a mirror reflecting contemporary attitudes to science and scientists.

Novels like Mary Shelley's *Frankenstein* had an ongoing impact on common culture and helped to create a myth about scientists, but the 'nerd' image must have already taken root. So where did Shelley get her inspiration from, (did she go to a really bad dinner party as depicted in Ken Russell's *Gothic*?) and why has the image survived into the 20th century? And will it dissolve by the next century?

Strange and misguided versions of scientists range a long way back in history. The 14th century form of laboratory chemists, the alchemists, were branded as dabbling in black magic and drew accusations from writers such as Chaucer who accused the alchemists of being 'charlatans'.

Historically, science was largely a hobby for the rich and idle. To others their pursuits often appeared irrelevant and even ridiculous. References to 'silly' scientists emerge in the 18th century such as Shadwell's play *The Virtuoso* which presents a comic scientist. This play also inspired many satires. Romantic writers later in the 19th century commonly depicted scientists as 'deficient in emotion, human aesthetic, and humanity'. This is around the time of the birth of *Frankenstein* and its creator Shelley.

For a period, this image of science changed in the latter half of the 19th century as science began to produce inventions that were economically useful, made life easier, and provided entertainment, thus the image of the 'utopian' scientists emerged.

H.G. Wells, who was trained as a scientist, was so disturbed by the optimism of Victorian age science that he wrote such graphically horrifying novels as *The Island of Dr Moreau* and *The Invisible Man*. Wells explored the potential amorality that can result when the notion of science claims to be value free.

The evil physicist re-emerged in the 20th century, both in literature and more recently in the new electronic media, one of science's own inventions (consider Dr Brian O'Blivion in David Cronenberg's *Videodrome*). The evil physicist could probably be attributed to the result of what we could term 'the shock of Hiroshima' upon the human conscience. After 1945, it became clear that science was not under control and that scientific discoveries do not necessarily raise the standard of living. Science exploded on to the silver screen as a moral issue and a moral responsibility that concerns all life forms on the planet. Sci-fi in the '70s depicted many a helpless scientist, involved in either a project or experiment gone wrong or out of control. These films were usually resolved in 'Hollywood' style endings. So the image of scientists can be seen to have grown from a build up of centuries of literature, the actual emergence of science and a reaction to science, whether it be from philosophical or religious viewpoints.

'Nerd-dom' is perhaps already starting to be a withering camp as movie producers burn their pocket protectors. The Nutty Professors are replaced with the 'coolest' of archaeologists like Indiana Jones and other scientists with a social conscience. They can even have a sense of humour considering the 'scientific' dialogue in *Ghostbusters*. So maybe we can look forward to a new market in the media, perhaps something like 'L.A. Science'? Perhaps it will even go as far as scientists 'footy' cards in bubble gum packets or scientists appearing as characters for the game 'celebrity heads'. It was, after all, a quiz game that first brought Barry Jones to the public eye in Australia.

Dr Andrea Horvath works with the CSIRO Science Education Centre in Melbourne.

Back off Man, I'm a scientist

Ghostbusters provides the hippest Hollywood scientists yet. Challenging both the academic establishment and the notion of 'nerd' the Ghostbusters face many of the trials and tribulations of experimental science.

When the university decides to terminate their grant (at the beginning of the movie), the dean denounces Bill Murray saying: "Doctor, we believe that the purpose of science is to serve mankind. You however see it as a dodge or hustle. Your theories are the worst kind of popularist tripe, your methods are sloppy and your conclusions are highly questionable. You are a poor scientist."

Murray looks aghast, crying out, "But the kids love us."

Once unemployed Murray notes that, "Einstein did his best work as a patent clerk."

Dan Ackroyd rejoins in a tone of terror: "I've worked in the private sector—they expect results".

And like all top research and development scientists, he asks "Where are we gonna get the money?" And Murray admits "...I

don't know".

They persist against the odds and the Ghostbusters is established. Now mortgaged to the hilt, Ackroyd states: "We are on the threshold of establishing the indis-

pensible defence science of the next decade. Professional paranormal investigations and eliminations – it will make us rich beyond our wildest dreams."

Public scepticism remains high. When Sigourney Weaver tells Murray that he doesn't act much like a scientist he admits, "They're usually pretty stiff". "You're more like a game show host," she says.

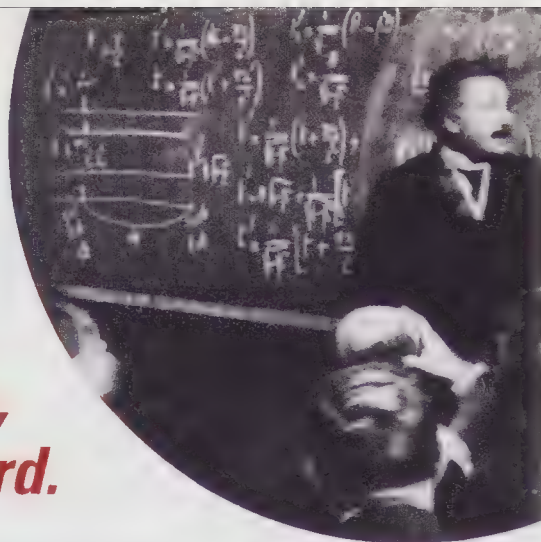
Murray's best response to a sceptic is the line all scientists should use when questioned by the dubious and doubting: "Back off Man, I'm a scientist."

But, the Ghostbusters go on to save the world and the 'scientists' for the moment are heroes.

ABOVE: RICK MORANIS AS THE NERD SCIENTIST/ACCOUNTANT IN *GHOSTBUSTERS II*.
LEFT: THE GHOSTBUSTERS WITH FRIENDLY GHOST.



Van Gogh and Mozart didn't have exclusivity on the hard road to genius. Scientists and mathematicians have their share of drama too, finds Ashley Crawford.



Everyone knows of Mozart's poverty, Beethoven's deafness, Van Gogh's suicide. Why then do so few know of Alan Turing's equally tragic suicide or Kurt Gödel's self-imposed starvation? Some people are aware of Stephen Hawking's severe physical disabilities, but there are many other poignant stories in the worlds' of science, that strike at the same level of achievement and tragedy as those of art and music. Indeed, some of the most momentous and fascinating achievements in science have emerged from no less bizarre, eccentric, and often tragic, figures.

Which is not to say that all scientific geniuses are away in cuckoo-land, but there's little disputing that quite a few of them were (and are) not exactly dull citizens.

Consider the inventor of the first 'computer', speedometer and the 'cow catcher' on trains. As early as 1823, the English mathematician **CHARLES BABBAGE** (1792-

Mad... [or just sad] ...Scientists



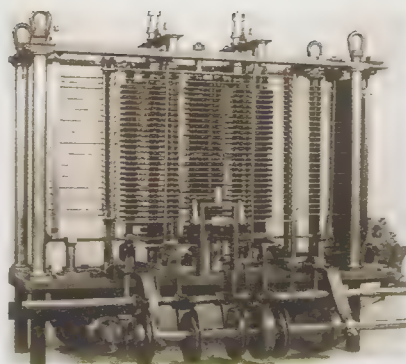
Obsessed with a vision of the programmable computer, Charles Babbage, never had a happy day in his life.

1871) suggested a machine for tabulating mathematical calculations to 20 decimal places. In 1834 Babbage began 20 years work on the first analytical computer, called the Analytical Engine, and the first 'calculator', the Difference Engine. After 1854 the British Government cut Babbage's funding, a short-term view if ever there was one.

Babbage was a lonely man, obsessed with a vision of the programmable computer. However he did maintain a long-term liaison with the only legitimate child of the poet Lord Byron, Lady **ADA LOVELACE**. She became as obsessed as Babbage with the project and contributed many of the ideas for programming, including the invention of the programming loop. In her writings on the Analytical Engine she pre-empted the notion of artificial intelligence by stating that, although the computations of the Analytical Engine could not properly be regarded as "thinking", they could nonetheless perform activities that would otherwise require the extensive application of human thought. She also speculated on the potential of the Engine to play chess and compose music.



Ada Lovelace is regarded as the world's first computer programmer and has been honoured by the United States Defence Department which named its primary programming language, Ada, after her. She died a painful death from cancer at the age of 36, leaving Babbage to pursue his lonely quest. Despite his exhaustive work, neither the Difference Engine or the Analytical Engine were ever completed and near the end of his life he stated that he never had a happy day in his life. Only a few mourners attended his funeral in 1871, however both IBM and Apple have much to be grateful for from Charles Babbage.



KURT GÖDEL (1906-1978), an Austrian-American mathematician, published a 1931 paper 'On Formal Theoretical Advances' arguing that not all mathematical problems are answerable and that any program for producing consistency in theory will ultimately break down, i.e. that mathematics contains unresolvable paradoxes. Gödel's 'incompleteness (or undecidability) theorem' had a major impact on the very basis of mathematical theory.

Gödel, however, was not an all together happy man. Shortly after his paper was published he was asked to lecture at the newly formed Institute for Advanced Study at Princeton University, an academy described as a "gabled, medieval fortress straight from out of the Dark Ages... inside it looked like a dungeon...it gave you the feeling that you were inside the House of Usher". It was a setting that the melancholic Gödel fitted into handsomely.



In 1934, at the age of 28, Gödel was admitted to a sanatorium outside of Vienna for treatment of nervous depression. He was heartsick. Gödel had met a dancer in a Viennese nightclub and wanted to marry her, however his parents were vigorously opposed to the union and the mathematician, apparently ever submissive to authority, obeyed. A year later, and after six weeks at Princeton, Gödel suddenly resigned on the basis of overwork and depression. He returned to Vienna and married the dancer but lost his job and received a conscription notice to report to the Nazi army for a physical. The greatest logician of the time was hungry and facing a long goose step through the snow. Fleeing to America and the Institute, Gödel befriended Albert Einstein. However, he remained a loner and, in a faculty renowned for being full of oddballs, Gödel was still the odd man out.

As years went by, the melancholic mathematician became more and more like a figure from an Edgar Allan Poe story. He would sit at home reading about theology, ghosts and demons. By 1970, preoccupied with ailments, real or imagined, he became increasingly skeletal – at 1.7 m tall Gödel weighed only 39 kg. The great theorist was described by his doctor as suffering from "a severe personality disturbance, with secondary malnutrition, and some somatic delusions – inappropriate ideas about his bodily structure and function". He died on January 14, 1978, "of malnutrition and inanition caused by personality disturbance". His theory of incompleteness however, lived on.

While Gödel was destroying the foundations of mathematics, the tortured, homosexual Englishman **ALAN TURING** (1912-1954), was building the foundations for testing the parameters of Artificial Intelligence. In 1936 Turing published a paper 'On Computable Numbers' proposing a theory of how a universal computer would work, encompassing Babbage's initial work and embodying the logic of all future computing machines.



Above left: Replica of Babbage's Analytical Engine which foreshadowed the modern computer.

Above right: The world's first computer programmer, Ada Lovelace, died a painful death at the age of 36.

Left: Like a figure from an Edgar Allan Poe story, Kurt Gödel was the odd man out amongst a faculty of odd balls. Below: A tortured homosexual, Alan Turing set the parameters for testing Artificial Intelligence as well as cracking the Nazi's secret code.



Far from the image of scientists and mathematicians as personally uninspiring 'nerds' leading sedate, laboratory-bound lives, quite the opposite is true. The figures cited here are but a few of what would be a truly massive list of lives led in the pursuit of high goals and higher costs to their personal lives.

During World War II he worked for the British Code and Cypher Unit, providing a constant stream of decoded military messages that were instrumental in turning the tide of the war. He cracked 'Enigma', the Nazi's secret code which had appeared impossible to break into by the Allies. Perhaps most importantly he proposed the 'Turing Test' – a theory of testing the extent of Artificial Intelligence which remains the most widely applied standard for A.I. today.

Like Babbage and Gödel, Turing lacked a certain cheery disposition. Turing's mother, Sara, wrote about him riding a defective bike to work. Having repeatedly taken a rag and turpentine with him to clean his hands when the chain fell off, instead of fixing the chain he began to record the symptoms, counting turns and devising complex calculations to nudge the chain with his heel before it came off. His mother pointed out that a mechanic would have fixed it in five minutes.

Turing was the first to figure out – in highly abstract terms – how to design a programmable computing device. On a theoretical level he went further than this to propose the question "Can machines think?"

Turing noted that people's 'intelligence' is judged most often by their speech and offered the pragmatic test of a machine's intelligence by suggesting that it could be deemed intelligent when it could pass for a human being in a blind test. It is a test which has been put into practice intensely at such computer research laboratories as Massachusetts Institute of Technology (MIT) over the last 20 years.

However Alan Turing, an undoubtedly eccentric and troubled man, committed suicide in 1954 after conviction for a homosexual offence.

Turing's test for the intelligence of machines has been explored in numerous research organisations around the world. Perhaps the most advanced has been the work of Nicholas Negroponte, director of MIT, and his team. For some years they have used a 'conversational desk-top computer' to take phone calls and claim that few callers had realised that they were conversing with a computer!

The most contemporary figure of science who can be seen as having led both a tragic and, at times eccentric, life is **STEPHEN HAWKING**. Almost totally paralysed, without the power of speech and confined to a wheelchair, Hawking is able to move only his facial muscles and two fingers of his left hand. However at the age of 50 Hawking has become the world's most renowned physicist and his 1988 book, *A Brief History of Time*, has sold millions of copies world-wide.

While still a graduate student, the physicist became intrigued with the notion of 'black holes' which are formed during the death of large stars. With mathematician Roger Penrose and using Einstein's theory of relativity, Hawking created techniques proving mathematically that black holes contained 'singularities', infinitely dense centres with irresistible gravity. He went further, using quantum theory to prove that the black holes emitted radiation – thus going against the universal theory that nothing could escape from a black hole. He has since been vilified on the idea and the escaping radiation has been titled Hawking radiation.

Hawking's debilitating illness set in at age 21 and it must be said that if anything it has propelled his now huge media image. Accordingly, much of his personal life has been fodder for television and newspapers. The fact that he carries an almost obsessive fascination for Marilyn Monroe (a poster of the starlet sits opposite his desk in his Cambridge office) through to his recent break-up with his wife of 25 years to move in with one of his nurses has only added to the mystique.

Far from the image of scientists and mathematicians as personally uninspiring 'nerds' leading sedate, laboratory-bound lives, quite the opposite is true. The figures cited here are but a few of what would be a truly massive list of lives led in the pursuit of high goals and higher costs to their personal lives. Nevertheless, the sacrifices made by Gödel, Babbage, Turing, Hawking and others changed the course of human creative and scientific understanding. ■



*The 25 year itch:
Stephen Hawking left his wife,
wrote a bestseller on black holes
and talks with the aid
of a machine.*



NEXT

NEWS AND TRENDS

Australia helps search for life in space

The eternal question 'is there other life out there in the universe?' will be given scientific footing in October with a \$US100 million, 10-year Search for Extraterrestrial Intelligence (SETI) survey.

The SETI Institute (a non-profit body contracted for the search by the American space agency NASA) and the Australia Telescope National Facility are negotiating to play a leading role with NASA, for allocating the 64 m dish at Parkes in western NSW to the survey for five months from early 1994.

SETI will begin its work in the northern hemisphere, using radiotelescopes at Arecibo in Puerto Rico and Goldstone in California to search for signs of technologies or civilisations in other star systems.

The Arecibo dish will search within our galaxy, targeting about 1,000 stars like the sun stretching out to a distance of about 100 light years. In parallel, NASA's Goldstone tracking station will conduct an "all-sky survey".

Parkes is set to become the centre for scanning the radio emissions of about 200 star systems which can be seen only from the southern hemisphere.

After completing a survey at Parkes in April, American radio-astronomers have concluded that the big dish there is an ideal location for the southern hemisphere part of the quest.

The scientists will be looking for signals that are characteristic of a technology rather than the natural radio emissions from galaxies and stars. They expect the tell-tale signs of life 'out there' to be continuous wave, narrow-band signals or pulsating signals.

The myriad signals reaching Earth from galaxies, quasars, pulsars and the like, however, are mixed with a profusion of others generated on Earth from radio, TV, taxis, radar, garage door openers, satellites and so on. To recognise Earth-generated interference and ignore it, the SETI Institute has built 'smart' computers which will sift through the myriad signals received from Earth and outer space.

Dr Jill Tarter of the SETI Institute says the team came to Parkes to see how smart they had make their computers by 1994. For this, the dish was pointed straight up at the sky and sensitive tests conducted to identify the source of every signal and measure its level of interference.

According to Dr Peter Backus, also of the SETI



LARRY WEBSTER OF NASA (LEFT) AND JILL TARTER AND PETER BACKUS OF THE SETI INSTITUTE AT THE PARKES TELESCOPE. JILL'S T-SHIRT READS 'GOOD PLANETS ARE HARD TO FIND'. (PHOTO: PETER POCKLEY)

Institute, their observations were so free of interference at times that the team began to wonder whether their equipment was working: "It's been just remarkably quiet and we're most excited about coming down here in 1994 to make some very sensitive observations". Occasionally, transmitters on satellites going overhead swamped all other signals, but this is true anywhere else in the world.

NASA plans to fly a military transport aircraft from the USA with a container of SETI Institute receivers and a supercomputer and then truck it to Parkes. In order to detect the faint signals which might be coming from other civilisations on distant planets, the Institute has developed equipment which can listen to tens of millions of radio frequencies simultaneously.



RON ECKERS (LEFT), DIRECTOR OF THE AUSTRALIA TELESCOPE, DISCUSSES TESTS FOR INTERFERENCE IN THE PARKES CONTROL ROOM WITH JILL TARTER AND PETER BACKUS. BELOW: AERIAL VIEW OF THE TELESCOPE. (PHOTOS: PETER POCKLEY)

Dr Tarter calculates the total energy of all the signals collected by all the world's radio telescopes over the past few decades is equivalent to that of a snowflake falling to the earth.

The SETI computer will talk to the Parkes computer, directing the telescope through fully automated observations round the clock.

Nobody will be calling out "Eureka!" when, as Dr Tarter and Dr Backus confidently expect, the first definitive signals from another civilisation are detected, as the sifting will all be done systematically by computers.

The SETI scientists want to be seen as serious astronomers. They say they don't have a spiritual

or mystical approach to their quest. Dr Tarter's personal view is: "Nobody would work on a project like SETI unless they were intrinsically convinced that there are other civilisations in the universe.

"The thing that is most striking to us is the large numbers. There are 400 billion stars in our own galaxy, the Milky Way. There are as many galaxies in the universe as there are stars in the Milky Way."

Nonetheless, they get bothered by people confusing their project with the claimed observations of UFOs. "UFO people have to sign up to the same kinds of standards of critical examination," says Dr Tarter. "For us to believe them it has to be repeatable or independently verifiable and credible – and it never is."

The SETI Institute people acknowledge criticism of their quest by fellow scientists but claim there are only very few who say the answer is that nobody is out there and SETI is a waste of money.

Dr Tarter says it has been easy to justify the cost of SETI to the US taxpayer. "All humans throughout recorded history have been fascinated by this question of: Are we alone? What's our place in the cosmos?"

"In the past we used to ask the priests and the philosophers to answer that

question for us and to give their opinions. Right now it turns out that it's possible for scientists and engineers to try and make an experimental test rather than just offer their opinions."

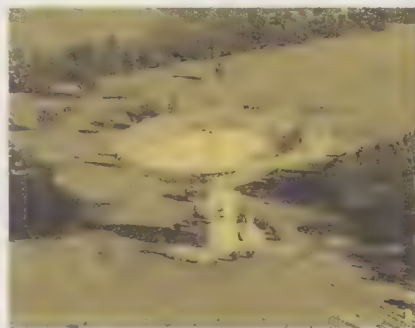
Will other civilisations detect signals from Earth? The early radio transmissions of the 1930s have now gone out 60 light years into space. Early TV transmissions from the 1940s have gone out 50 light years.

Dr Backus says: "These signals have perhaps passed by dozens of stars like the sun and perhaps there are beings on planets orbiting some of those stars who have detected evidence of intelligence here on earth by means of these signals drifting through space".

The NASA project will only be listening for signals and has no plan for sending out any coded signals, like the most powerful outgoing one transmitted in 1974 by the Arecibo Observatory. That signal was directed to a globular cluster of

stars about 25,000 light years distant and would take 50,000 years for a reply.

But what if a definite signal from another civilisation is detected, perhaps at Parkes? Dr Backus concludes: "It will be up to this planet, all of humanity, to decide whether or not we reply".



And God created biology students...

As many as one in five first-year university biology students believes in the literal interpretation of the Bible's 'Book of Genesis', rather than the theory of evolution, according to a national survey conducted for the Australian Institute of Biology.

The highest scores occurred in two Sydney universities: the University of Technology, closely followed by the University of Sydney.

The theory of evolution, as refined and developed since it was first promulgated by Charles Darwin last century, is based on scientific evidence that the Earth was formed 4.6 billion years ago and that life has been evolving steadily for about 3.5 billion years. Evolutionary theory is totally opposed to the creationist belief that the Earth was formed 6,000 to 10,000 years ago (depending on how the Genesis 'timetable' is calculated) and that all life was formed in six days.

On a national basis one student in eight (12.6 per cent) chose the creationist option that: "God created man pretty much in his present form at one time within the last 10,000 years". Of the

responses obtained from 4,255 students from 17 universities in all States and the ACT, 535 chose this creationist statement.

Choices from the other two statements were almost evenly split between those who adhered to evolution but differed about the existence, or actions, of God. Forty one per cent believed in evolution over millions of years guided by God, and 43 per cent in evolution without God. Less than three per cent of the returns were informal.

The lowest scores for creationism were shown at Perth's Murdoch University (3 per cent) and the Australian National University and the University of WA (both with 4 per cent).

Surprisingly, Queensland, thought to be the stronghold of creationism, was very close to the national average. (Under the Bjelke-Petersen government, creationism was first allowed to be taught alongside evolution in science classes; this is expressly forbidden in other States.)

The results show fundamentalist, anti-scientific beliefs persisting in the minds of many young people despite the teaching of evolutionary biology in schools. Whether these young 'creationists' lead an intellectually split life, answering exam

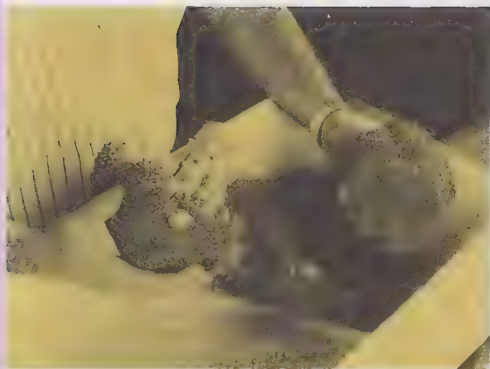
questions on evolution 'according to the book' while privately believing their answers to be wrong, is not revealed by the survey.

President of the Institute of Biology and professor of ecology at Queensland's Griffith University, Roger Kitching, stressed the survey was not anti-religious: "Rather, biologists are opposed to the creationists' primitive mythology about life on Earth; they promote a literal rather than an allegorical interpretation of the Genesis story. We can't have science with mysticism built into it.

"There is a tendency among biologists simply to assume evolution as received wisdom. The survey shows that biology teachers should pay particular attention to explaining it better," Professor Kitching said.

The national survey was conducted for the Institute of Biology by Barry Price, a Sydney Catholic, former co-ordinator of both science and religion and author of the 1990 book, *The Creation Science Controversy*.

Price likens the results to "a virus infecting biology students; there is no reason to believe the infection is not also present in all other faculties of the universities".



BROCCOLI PRESERVED IN 'SMART FILM'. (PHOTO: CSIRO)

Sleeping food

The perennial problem for the fresh produce and flower industries is limited shelf-life. For growers seeking export markets, the only answer has been expensive air freight.

CSIRO has launched new plastic films that will extend the short shelf-life of agricultural and horticultural products to enable their reaching export markets by sea.

The plastic controls the gases which cause ripening and decay. Just enough oxygen and carbon dioxide are let in to keep the fruit, vegetable or flower alive, but 'asleep'. Ethylene which causes ripening is removed by impregnating the film with a chemical which soaks up the gas.

The wrappings which have to be tailored to each product also control the humidity of the air inside the packaging and the growth of fungi. CSIRO claims the new export market could be worth \$300 million a year.

The Russians are coming

Not long ago the Cold War ensured that satellite images of portions of the Earth obtained by one side of the Iron Curtain were jealously guarded from the other, especially when they were taken over 'enemy' territory.

Now, remote sensing experts from Australia and Russia are combining in a joint venture, through establishing a Mapping and Primary Resources Application Centre in Australia.

The Centre will combine Russian expertise in mapping and geodesy (measuring the shape of the Earth's surface) and Australian applications and experience in analysis of space photographs. Australians will have access to pictures of the Earth taken in high resolution by Soviet satellites and will help in resource development in both Russia and Australia and our region

Wattle bread on the menu

Scientists studying traditional Aboriginal foods believe that seeds from Australian wattle trees could become a major source of food for famine areas of the world.

The acacias, or wattles, thrive in semi-arid conditions similar to those found in most developing countries with a critical food shortage.

Dr Chris Harwood and Dr Alan House of the CSIRO Division of Forestry have shown that acacia seeds are very nutritious, being rich in protein, carbohydrate and fat. There has already been a successful taste trial in Africa. ■

Three records for the book of life

1. LARGEST LIFE

An unusual race has broken out to record the largest living organism on Earth. No, it's not a new whale or giant tree that is vying for the prize, but some humble fungi.

First it was reported that a root-infecting fungus, called *Armillaria bulbosa*, had been found in Michigan, USA. Weighing in at more than 10,000 kg and occupying 15 hectares, it is 1,500 years old.

Then a worthy competitor emerged when the State of Washington, in the north-west of the USA, claimed the record with another fungus, *Armillaria ostoyae* covering 600 hectares. It is a mere youngster by comparison with its Michigan rival, being only 400 to 1,000 years old.

The Washington fungus sounds less friendly. *Armillaria ostoyae* is a killer fungus that can wipe out whole populations of trees.

Being the first or the biggest is as important to scientists as to athletes and the fungi have provided a new form of record chase. Oregon State, also in the US, is about to enter the competition.

2. HOTTEST LIFE

Ants native to the Sahara region have been discovered to be the hottest life forms on Earth.

The Sahara silver ants *Cataglyphis bombycina* can tolerate temperatures up to 53.6°C, the highest recorded for any land animal.

According to a paper published in *Nature*, the silver ants tread a narrow line between heat exhaustion and being eaten by lizards. They are the only segmented invertebrates, like insects and spiders, which seek food in the full midday sun of the Sahara.

The ants emerge from their shelter when temperatures reach 46.5°C which is too high for most desert creatures, including lizards which would prey on the ants. Because their bodies can withstand higher temperatures, the silver ant can attack other creatures stranded and exhausted on the surface of the desert.



ABOVE THE SAHARAN SILVER ANT WHICH THRIVES IN RECORD HEAT. (PHOTO: NATURE) BELOW: PURPLE TUBE ANEMONE (PHOTO: AUSTRALIAN INTERNATIONAL)

If the temperature goes above 53.6°C the silver ants would themselves die by drying out. But by perching on stalks of dry grass where the heat is less intense, a silver ant can cope with surface temperatures up to a sizzling 60°C.

3. DEEPEST LIFE

Biodiversity has taken on a new dimension with the discovery of an astonishing variety of life-forms in the ocean depths. The results suggest the sea may contain 10 million species, more than probably exist on the land.

Surveys of deep-sea life off the eastern coast of the US uncovered no less than 90,677 individual animals living in a total area no larger than two tennis courts.

It's not the sheer size of the populations which is so breathtaking, but the fact that there were 798 different species representing 14 phyla (a primary or sub-kingdom of closely related animals or plants). The number of phyla found on land is no more than 11.

Nearly half of the deep-ocean species were segmented worms, a quarter were arthropods (mainly various kinds of crustacean) and one-eighth were molluscs (the family of snails and clams). The samples were taken from 233 box cores, each measuring 30cm² at depths of 1,500 to 2,500m off the New Jersey and Delaware coasts.

The scientists, Dr Frederick Grassle, of the Woods Hole Oceanographic Institution and Rutgers University and Dr Nancy Maciolek, of Battelle Ocean Sciences, say the richness of animal life in the deep sea is much greater than previously thought.

"Thousands of species of small invertebrates living on or in the sediments of the deep-sea floor co-exist in a shifting mosaic of microhabitats," they write.

The results dispel the long-held notion that the oceans are vast 'deserts' which are so short of food that living things are very thinly spread through them. Grassle and Maciolek reckon that about 100 new species are found along every 100 km of ocean floor they studied.

They applied this figure to the total area of ocean floor which is deeper than 1,000m (300 million km²) and came up with the figure of 10 million species of marine animals. Even this estimate, they say, "is probably conservative".

According to Grassle and Maciolek's paper in the *American Naturalist*, theirs is "the first such extensive quantitative sampling of deep-sea communities".



From Disneyland to domination

After years of 'Mickey Mouse' marketing, Euro-science is getting serious. James Ruscoe examines the proposed policy changes in R&D.

Europe's billion dollar research and development (R&D) programmes have undergone major revaluation as Europe ponders losing the R&D race to the US and Japan.

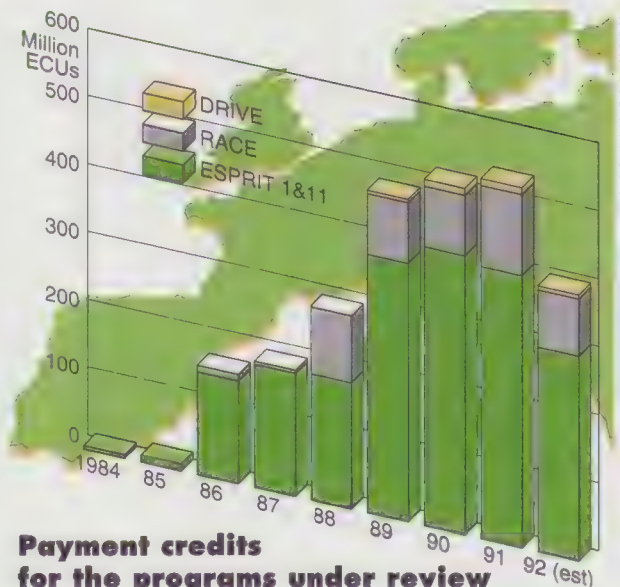
The evaluation was tackled by The Information and Communications Technologies Review Board, established to consider the multi-billion dollar information technologies arm *Esprit*, the advanced communications technologies group *Race* and *Drive* in applications linked to transport.

Philips Electronics' chairman, Wisse Dekker, gave seven major industrial heads, including the scientific directors of IBM and Fiat, a brief that took in the rapidly evolving Information and Communications Technologies scene in Europe and beyond.

Both *Esprit* and *Race* are regarded internationally for stimulating major new

R&D. Despite this, the Board recommended terminating them, along with the smaller *Drive*, proposing instead a new three programme structure designed on radically different lines and responding to what are perceived as new priorities in science policy.

The biggest programme, and a major innovation, is a new initiative, CRANE – Community Research Actions for a New Europe. This is oriented to R&D results closer to the marketplace, able to contribute directly to sustaining and expanding European industrial competitiveness. A vertical programme, CRANE is intended to create supply chains from idea to innovation to marketable product or process via consortia of firms working together in the context of 10 year visionary goals. The objective is dominant global market share in expanding mass-market sectors. Dominant global market share sets Europe against world markets, destroying the notion that R&D in Europe is only about catching up. CRANE has more



Payment credits for the programs under review

in common with Japanese practice, demanding partnership between industry and the EC in management as well as orientation.

The second programme accepts best practice ➤

Mega memory

Hitachi officials claim they have produced the smallest computer memory cell. With a surface area of 0.72 square microns (1 micron = 1/1,000th of a millimetre) Hitachi predicts the mass production of 256 megabit dynamic random access memories will be available by 1998. The circuit pattern was achieved through the use of optical lithography and ultraviolet light. *Nikkei Weekly*

Brighter than a hundred Milky Ways

Astronomers at the Australia Telescope National Facility have discovered two megamasers, or hyperenergetic radio galaxies, which are providing insights into the behaviour of galaxies and how the universe evolved.

Megamasers are the most energetic objects in the universe and have a luminosity 100 times that of the Milky Way. The acronym stands for mi-

crowave amplification by stimulated emission of radiation. The facility, assisted by the Anglo Australian Observatory and Sydney University, says the emissions are believed to be radio waves from the action of a massive black hole on dense clouds of hydroxyl (OH) molecules.

Intense debate is raging between astronomers as to the cause of the energy levels. Two views vying for credibility are first that the energy is the result of star formation. The second is that it is caused by a hungry black hole.

Microwave logs

Researchers in Japan have been working on new techniques to increase the yield of even the most inferior timbers. By microwaving raw logs in a huge oven, they become soft and malleable owing to the high water content in the wood. Crooked logs can thus be straightened, while the formed timber is less likely to split. The compression process which pushes much of the water out of the timber increases the specific gravity and the strength of weaker timbers. Such timbers are already being used in Japanese construction. In another process the researchers can increase the strength of particle board by aligning the wood chips in a magnetic field, thereby producing a panel with the same strength as natural wood grain.

Experimenta

Over 100 Australian experimental films, videos, installations and multi-media performances have been selected from 350 entries for the November MIMA conference. The event includes a range of avant-garde films. Guests include the German video and holography artist



STILL FROM TETSUO: THE IRON MAN

Vito Orazem and Academy of Fine Art, Munich's lecturer in video and computer art, Michael Saup and screenings include the Japanese cyber-industrial fantasy *Tetsuo: The Iron Man*.

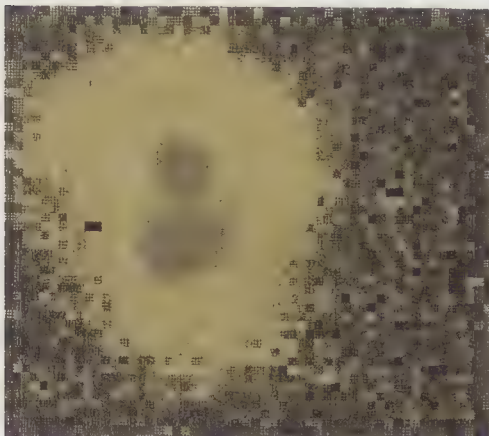
Sludge sale

The CSIRO in conjunction with Melbourne University have begun selling a sewerage treatment process to the Chinese that looks set to win a major share of the \$2.1 billion set aside by The World Bank for the cleanup of China's environment. The process claims savings of approximately 30 per cent in the cost of aerating sewage tanks. It targets nitrates in the smelly sludge, thus attacking an element responsible for the growth of algal blooms in rivers and lakes.

Electronic art conference

The Third International Symposium of Electronic Art (TISEA) will be staged in Sydney from November 9-13 1992. TISEA is a forum for artists, scientists, technologists and musicians exploring art, science, media and robotics. Themes for the conference include cyber-aesthetics, artificial life, technology and culture.

MEGAMASER, SIMILAR TO THOSE DISCOVERED BY ASTRONOMERS AT THE AUSTRALIAN TELESCOPE NATIONAL FACILITY. (PHOTO: COURTESY CSIRO, DIVISION OF RADIO PHYSICS)



► technologies and processes as important as innovation in raising competitiveness of complex advanced productive systems. Until now R&D policy has focused on technological excellence in ultra-advanced science, an element boasted about to justify R&D budgets (albeit with the Japanese being left to exploit the inventions commercially).

ARC—Applications of Research to Competitiveness—also concentrates on what science can do for industry and society. R&D has often been chosen more for the challenge to scientists than for the firms' success or European competitiveness or economy. Rejuvenation of mature industrial areas and upgrading infrastructure is a key element in ARC, offering opportunities to leverage the R&D spend with massive EC funds, adding hitherto lacking hi-tech input to regional development. Parallel proposals relate to stimulating investment in results from EC programmes.

Fundamental research has not been neglected. The third strand in the proposed strategy is Basic Action for Systems in Information and Communication. BASIC would be a speculative programme, but linked to a new internationally oriented technology observatory picking up areas of scientific promise wherever they occur. *Esprit's* very valuable networks linking European scientists would be reinforced and extended under BASIC.

The Board recommends a modest 15 per cent increase in the ICT R&D budget to cover these proposals. Central to its strategy is the need to switch science policy from 'technology push' to 'market pull'. The technology push has always ruled the defence sector, where the market is taken for granted once scientific feasibility is established. The defence sector dominated the post-war economy and so the notion spilled out from there to gain generalised acceptance. But it is science-driven and ignores business plans: it thus inevitably translates into poor take up and diffusion of results and lack of response to the market. In Europe, this means that European scientific excellence constantly finds industry unprepared, unwilling or even unable to profit by its advances and discoveries. This gives the Japanese and the Americans an entry.

Strategically, the EC has to get the R&D financial and organisational structure right; rejuvenate infrastructure and utilities, which absorb far too many resources for social ends, and force them to compete while, simultaneously, get the market priorities clear and place industry and the whole private sector in front of its responsibilities. Then excellence in science will do the rest and the European economy can enjoy a hi-tech led growth cycle. Otherwise, Europe risks being a cheap Science Park—and a cheap Disneyland—for the rest of the world.

The EC is discussing the proposals. The three programmes are unlikely to be adopted in their entirety—the EC does not work like that, especially when faced with radical choices. Still, the thinking behind this report is already colouring policy-making in ICT and elsewhere, at both the European and national levels. And, whatever the outcome, *Esprit*, *Race* and *Drive* will not be the same again. ■

James Ruscoe is an Associate of the Commission for the Future. His last feature for *21•C* was on the proposed European Carbon Tax.

**FIRST WE HAVE TO IMAGINE A BETTER FUTURE,
THEN WE CAN BUILD TOWARDS IT**

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Alistair Mant is an international authority on leadership and management development, and runs a world-wide consultancy practice. His books include *Leaders We Deserve*, *The Rise and Fall of the British Manager*, (quoted by Tom Peters in *In Search of Excellence*), *The Experienced Manager* (otherwise known as the Mant Report for which he was awarded the British Institute of Management's Bowie Medal).

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STRANGE WEATHER CULTURE, SCIENCE AND TECHNOLOGY IN THE AGE OF LIMITS

by Andrew Ross

Verso, London, 1991

REVIEWED BY MCKENZIE WARK

More than once the government has tried to launch visions of the future in this country, and always without success. "No child will live in poverty", the "clever country" and "sustainable development" have all met with derision and indifference, despite the obvious importance of the issues behind these slogans. Why is it that there is no sustainable public debate on science, technology and the future of both?

A new book by Princeton academic Andrew Ross offers some clues to this. In *Strange Weather*, Ross shows how the bold visions of the future and the trusting faith in science which characterised Western culture in the 1930s and again in the 1950s, have come undone.

Ross tracks the development of forms of popular culture on the fringes of the scientific world, and the role of the intellectuals who police the boundaries between legitimate ways of talking about technical matters and the nether realms of quackery.

Ross is not so much interested in which ideas really are nonsense and which have value. Rather, he focuses on the rules which govern such decisions, and the people who have the power to make them. *Strange Weather* covers futurology, new age mysticism, 'brain machines', 'cyberpunk' literature, computer hacking, science fiction and the public debates about global warming. A strange mix, but the point is to examine the connections between "culture, science and technology in an age of limits", as the book's subtitle puts it.

While scientists usually treat popular perceptions of their work with disdain or contempt, Ross argues there are complex and powerful connections between science and popular culture. He shows how popular mythologies about science contain political and social values, and how these have changed in an era when scepticism about the uses of science has increased markedly.

By comparing long-forgotten popular forms like pulp science fiction or the extraordinary Technocracy Inc

movement of the 1930s, to the present, Ross shows how popular culture has shifted from a naive fascination with the authority of science to a rejection of the use of this for totalitarian ends.

In the case of new age paramedical practices, Ross uncovers a complex set of debates and practices which stem from a dissatisfaction with orthodox medicine. While much of the new age stuff is obvious quackery, Ross shows how some stems from quite legitimate criticisms of orthodox medical practice and research. What is at stake in such conflicts, according to Ross, are struggles about what constitutes proper knowledge and who is entitled to claim they have such knowledge.

From the decline of faith in science Ross moves to the related decline in visions of the future. Again, recalling forgotten images of how the future used to be imagined can be sobering. Ross revisits a General Motors 'futurama' from the 1960s which featured a model of a mechanical behemoth which could churn out freeways through jungle, scrub or rainforest. The ways in which corporations and governments have changed their rhetoric about the future, and enlisted the services of the more pliable of the academic futurologists to do it, is a fascinating story.

While official discourse keeps co-opting popular perceptions, popular cultures keep inventing new ones. Ross picks up on the cyberpunk subculture (discussed in issue six of *21•C*). Cyberpunk blends the no-future stance of late '70s punk rock and art movements with the boom in low cost computer networking. He shows how the cyberpunk style was able to create a white suburban subculture, based

around home computers rather than garage rock bands. While Ross' analysis of this subculture is interesting, it could be strengthened by closer attention to the evolution of media technologies and the forms of social and cultural life they make possible.

One of the central cyberpunk slogans is that "the street finds its own use for things". Cyberpunks find their own way to use the cheap media technologies of our time, just as punks took the guitar and reinvented the garage band.

The ways in which corporations and governments have changed their rhetoric about the future, and enlisted the services of the more pliable of the academic futurologists to do it, is a fascinating story.

Ross makes the point that popular culture is not completely 'stupid' when it comes to technical matters. Any number of events from Chernobyl to global warming to the almost unbreathable air quality in western Sydney are convincing people that official and orthodox technical fixes are not always to be trusted. The idea that a powerful technocracy can be left to its own devices to make the country richer, safer and 'cleverer' no longer has automatic support.

PARADIGMS IN PROGRESS LIFE BEYOND ECONOMICS

by Hazel Henderson,

Knowledge Systems, Indianapolis, 1991.

REVIEWED BY FRANK FISHER

The Bush Administration has been caught with its paradigms down," Hazel Henderson asserts, because "the classical economic paradigm of trade still harks back to Adam Smith and his famous formula of 'comparative advantage', which even today dominates economics textbooks.

"It was a perfectly sensible idea in the 1800s when European countries were beginning to trade with each other and capital was as immobile as labour and resources. [But], under the global financial system of the 1990s [with]... capital... so mobile that trillions of dollars move around the electronic banking and trading systems every day... all the textbook theorising about trade is obsolete, since these huge financial flows dwarf trade flows between countries."

If ever there was a book and a person that warranted a grant to provide continuing editorial support it is *Paradigms In Progress* and Hazel Henderson. A comparison springs to mind. Stephen Hawking, author of *A Brief History of Time*, can share his insights with us because although severely disabled, he is a brilliant, British physicist. That is, he is male, a well-published physicist (a discipline still able to attract considerably more cash support than say economic history), British (a member of the G7 big, wealthy nations) and, it is worth noting, his disability coupled with his scientific brilliance is decidedly media-attractive.

Paradigms in Progress is potentially far richer in its implications for humanity than *A Brief History of Time*,



but is desperately in need of conceptual editing, is from an obscure publisher outside the powerful mainstream and, while by a brilliant person, this one happens to be *female* and a radical economist who made her name in economics via quite unconventional means.

Conventional economists attain their power through manipulating the known levers and flows that create and enable commerce. This access to the essence of politics leads us to a certain respect for them while still suspecting their motives and results most of the time.

Radical economists on the other hand, do not have such powers. By raising questions about the very bases of economics and power, exposing these as just a set of possibilities among many ways of organising society, they render themselves suspect *all* the time. They must gain their support "at the margin" from agencies that do understand the practical place of critical analysis and academic freedom (being paid to go beyond the conventional), both of which, to mainstream Australians, still smack of impractical luxury.

So why is Henderson so popular and why is her book worth reading?

For 30 years Henderson has worked at the forefront of the critical environmental movement, always understanding that social and environmental dislocation are rooted in human institutions. She also understands that these same institutions define the very ways in which we respond to dislocation. This lead her to join and create an extensive range of organisations that sought to foster awareness to these institutions and change them. They involve a great range of interests, from conventional equity, green and social justice concerns through feminism, development (both "human potential" and "Third World"), technology assessment and economic "think-tank" activities (often involving government) to futures studies. (Some of these are listed in the front of the book.) She is a fearless and articulate author and speaker sought after by numerous organisations all over the world. She has (necessarily) done all this with minimal resources and at considerable personal cost.

Paradigms in Progress reflects this marvellous breadth of insight into the institutions and the players responsible for our style of interaction with the environment, and the ways in which we are attempting to change them. Its concern is the process of economic change, the ways in which we understand, measure and direct it, who directs it and how the choice of directors affects it. It is a world-spanning catalogue of conventional structures in transition and new institutions in gestation; it offers details about these organisations and about their initiatives,

giving extensive "packages" of their manifestos and how they are changing. Raw data, statistics and interpretations of those structures and institutions are offered to illustrate existing conditions and the nature of the changes the author's "preferred futures" are taking.

She begins with an illustration of changing economic detail and follows this with a run through the ideas of many thinkers and organisations seeking to define intellectual frameworks that will encourage us to live with the rest of Earth's biosphere. She points to the increased awareness of conventional organisations to the new notions provided by the Gaia hypothesis (treating the Earth as a single self-regulating system), and to how they are building into their structures the connections which it exposes. She illustrates the limitations of major *indicators* (especially GNP) and offers us numerous alternative indicators proposed by many thinkers to incorporate the social and environmental contexts she isolates (as necessary to encourage sustainable life-

styles) into our institutional frameworks. In addition to extensive awareness to inter- and intra-national equity issues and consequences, she devotes a chapter to gender issues and the consequences of ignoring the value of women's work and the different stamp women bring to value in general. "We must never forget," she points out, "that, in the most scientific sense, *reality is whatever we pay attention to!* Indicators only *reflect* our innermost core values and goals, measuring the development of our own understanding." The final chapters, 'Greening the Economy & Recycling Economics', point out the enormous liberation of resources that we would enjoy if we did take Lovins' "soft energy paths" and redirect military expenditures. She gives us extensive cause for optimism in pointing to many initiatives already underway at all levels: individual, corporate, government and international.

While the book is full of optimistic detail and insightful one-liners like, "one does not debate with economists - one simply hires them", it is short on definition. What are the bases for instance, of "economism, earth ethics and systems theory"? It contains glaring (if minor) contradictions and simplifications: sometimes she suggests that *the people* are the source of all wisdom, while at other times they aren't. "Money is not a commodity in itself"....??

Henderson suggests environmental cleanup should be costed negatively into GNP without dis-

cussing the contradictory ramifications this has. More frustratingly, the book is short on a coherent theoretical basis upon which we might all hang our own particular paths. She might have elaborated the understandings that underpin her systems theory and the complex and interesting ways in which we are "connected to everything". Such an exposition would have enabled us to see where her numerous practical experiences fitted and to cast a new, clearer, light on our own. This is what some of us now see as environmental science: the practical social science that is gleaning and consolidating the new light being developed by innovative thinkers everywhere to expose the structures of thinking and action from which our current truths and action-proposals rise. It recognises that all these structures, truths and proposals are constructed by society and therefore we are intrinsically responsible for them all.

Henderson misses the opportunity to do this rigorously, skimming over the subtlety in favour of a clearing-house of illustrative initiatives. Consequently, her book is a "shot in the arm" for insiders, people like me who have been struggling with the same concerns for years. It could have offered these insights as backup to the powerful economic analysis of which she is so clearly capable. In turn, this might have helped empower those of us who would otherwise cling to a system that "spoils" both us and our world.

Contrary to her subtitle, these insights will not take us to "Life Beyond Economics" but to a multi-dimensional responsibility that places the formalisation (dollarisation) of value into a context accessible to, at least, a large minority of us rather than retaining it as the exclusive domain of politicians and formally trained and employed economists. Again however, to point up another inconsistency, re-empowering people with the levers to their own economy would mean reasserting popular control over much of production and its infrastructure. This in turn would mean recognising the potential inherent in so much hi-tech infrastructure to sabotage popular control. Henderson alludes to this, yet, in common with many social theorists, she remains a technological optimist, somehow unable to see the profoundly disenfranchising potential of technology released without broad societal capacity to be responsible for it. Who among our readers understands the social expectations that enable us to ride bicycles let alone to generate what we like to call artificial intelligence? ■

Paradigms in Progress is both a marvellous breadth of insight into the institutions and players responsible for our style of interaction with the environment... its concern is with the processes of economic change, the ways in which we understand, measure and direct it... it is a world-spanning catalogue of conventional structures in transition and new institutions in gestation.



NATURE'S MEDICINE CABINET

ROBYN WILLIAMS

Now we've seen our cats chew grass for its emetic effects and even heard of birds using chemically laden nest-building materials, presumably to keep pests away. But to suggest that an animal can seek out a medicine and take it in careful doses is hard to believe.



Robyn Williams' last feature for 21•C was on Oliver Sacks.

It assumes the beast can actually *foresee* effects in a very sophisticated way. But that's exactly what several leading scientists are saying about chimps and monkeys.

I first heard the unlikely name *zoopharmacognosy* at a packed press conference in Chicago. It was part of the recent meeting of the American Association for the Advancement of Science, a huge gathering of over 6000 scientists from all over the world, that brings together some of the most exciting ideas on the leading edge of research... and occasionally a few daft ones as well. Could this be one of the latter kind? With a title like *zoowhatsit* one starts to wonder.

But *zoopharmacognosy* simply means the recognition of the pharmacologically active plants by beasts and once you're past the bizarre name of this new field, the implications are fascinating. It suggests that primates, and perhaps other creatures, are able to practise everything from curative medicine to birth control.

The first speaker at the press conference was an elegant Englishman with a superb BBC voice and a professorship at Harvard. Richard Wrangham, an anthropologist, with Professor Eloy Rodriguez, his colleague from California, was the first to show that African apes were using certain plants for their pharmaceutical properties rather than for food; they were seeking out the leaves of *Aspilia* and, Wrangham noticed, eating them whole, without chewing.

He sent samples of *Aspilia* to Rodriguez' laboratories at the University of California, Irvine. Gland cells in the leaves turned out to contain a red oil, thiarubine-A, known to be effective against nematode worms, fungi such as *Candida albicans* (thrush) and even viruses related to the AIDS family (retro-viruses). If the chimps had chewed the leaves they would have been digested in the stomach. By swallowing the leaves whole they ensured that they passed into the small intestine to act against parasites there.

"It turns out after analysis that the chemistry of the plant is a very good antibiotic and anti-parasitic," says Professor Rodriguez. "And all the indications are that these animals know that."

Richard Wrangham and the famed ape-watcher Jane Goodall have observed chimps devour between 30 and 100 *Aspilia* leaves at one sitting. This seems to be enough to have the desired effect and yet sufficiently few to avoid the toxic doses that would otherwise poison the chimps.

Chimps have also been observed consuming leaves of at least four species of figs. These too were selected carefully in the morning and the apes ate them without chewing. Analysis again showed powerful biologically active chemicals to be present, killers of nematode worms.

At the Kibale Forest in Uganda, chimps were noticed seeking out *Rubia cordifolia*, a plant known to be used extensively in the folk medicine of Africa and Asia. It is known to be a potent cytotoxic agent (killing certain cells) and is now being investigated by the US National Institute of Health as a possible therapy for cancer patients.

Other chimps, in the Mahale mountains of Tanzania, were observed by primatologist Michael Huffman, of Kyoto University in Japan, to be suffering clear discomfort from infestations of intestinal worms. He saw them carefully

picking away the pith (and only the pith) of the plant *Veronia*. This part of the plant turned out to contain powerful terpenes and, Huffman found, was used for the same pharmaceutical purposes by the local highlanders.

Across the world, in Brazil, Karen Strier studies one of the rarest monkeys on earth: the muriquis, which live in but 12 tiny enclaves in the remaining rainforest along the Atlantic coastline. There are barely 500 of these monkeys left in the wild.

Strier, who is a professor of primatology at the University of Wisconsin at Madison, noticed that the muriquis seemed to wait for the start of the rainy season before eating plants that she is convinced trigger ovulation in females. Males, apparently, don't bother with the procedure. Professor Strier and her colleagues have watched the monkeys for over 10 years and she is convinced she has revealed an example of birth-control in these wild animals.

Kenneth Glander takes the case even further. He's a primatologist at Duke University in North Carolina and he believes that monkeys can even set out to choose the sex of their young. His particular monkeys are the howlers of Costa Rica. After over a decade of studying them he noticed



PHOTOGRAPH: COURTESY COCA-COLA CHIMPANZEE PARK, TARONGA ZOO, SYDNEY.

that several females continued to produce only males with a consistency that defied explanation.

So he took samples of everything he could think of: fingerprints, hair, blood samples, even dental casts. He tranquillised the monkeys with dart guns and examined them internally. Almost on a whim he measured the electrical conductivity of the female howlers' birth canals. "I figured that some day these measurements might fit somewhere," he says.

Professor Glander discovered a remarkably consistent gradient of electrical potential, sufficient, he theorises, to favour the passage of "male" sperm up the canal, rather than female-producing ones.

But why do this? He suggests that low-ranking females have little chance of survival (87 per cent die young) but greatly increase their status if they can manage to produce male babies. He surmises that the female howlers will pick out leaves at a new eating spot that will somehow alter their internal chemistry and change the uterus' electrical regime, thereby favouring sperm carrying the Y chromosome.

Professor Glander cites one female that managed to produce an uninterrupted succession of nine boys, two of which grew up to become alpha males and so leaders of the pack. For her the success meant not only survival, she also managed to pass on her genes to a vast number of generations, thus satisfying evolutionary demands as well.

Far-fetched? Possibly. But Professor Glander is testing these hypotheses in his lab at the Duke University Primate Centre and whatever the outcome, *something* must be acting on the howlers' physiology to select the sex of offspring, so why not diet?

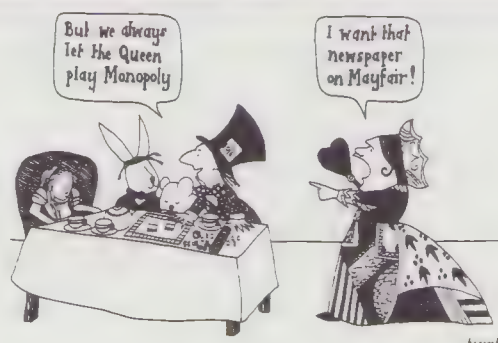
All this *pharmacognosy* has at least two far-reaching implications, apart from the intriguing discovery that primates are able to use the medicine cabinet provided by their natural habitat.

One is that we may be having more drastic effects on animals than we realise as we cut down their natural homes. The removal of some innocuous plant species seemingly foreign from an animal's regular diet may turn out to be a key occasional ingredient of its healthy livelihood.

Another is our own history and medical past. As more and more folk medicine transpires to be used by animals as well, so it seems likely that human pharmacology may have been based on watching the antics of beasts. As Professor Wrangham told the astonished press conference in Chicago: "Medicine may actually be over six million years old and have a non-human origin".

As so many of our celebrated modern drugs (anti-cancer agents, treatments for heart disease) come directly from a knowledge of their use by folk living in rainforests, it makes one wonder what there is yet to discover out there. ●

As more and more folk medicine transpires to be used by animals as well, so it seems likely that human pharmacology may have been based on watching the antics of beasts.



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AUTO SAPIENS

"How can I help you?" said the San Francisco airport, car rental attendant with that genuine imitation 'have a nice day' smile that Americans seem to have patented. "I've made a reservation for a sub-compact," I said.



Peter Fries is a columnist with The Australian. This is his first column for 21•C.

He fiddled the computer fiddle of a technophobe and enthusiastically told me that yes, they did have my reservation and would I like to upgrade to a full size car for "just an extra five dollars a day"?

Even if I could afford it, I wouldn't have taken the full size car – being a green kinda guy and all. Not green as in, "Hey guys, how come you have ski masks on inside a bank in the middle of summer?", but green as in a no phosphate recyclable eco-plastic environmental kinda way. So, I politely declined with the same 'have a nice day' smile.

"Well sir," he replied in what had become duelling smiles, "we'll have to upgrade you anyway because we don't have any sub-compacts left".

Slick. Very slick. I chuckled the chuckle of self-righteous indignation of having beaten a scam.

He then proceeded to offer instead the Satan-mobile itself – a sports convertible with that most black magic of incantations – "no extra charge". I was tempted, but resisted. "Do you have anything that gets good mileage?" I asked quite sincerely. His smile began to wane and I could tell that I was pushing the envelope of customer servility.

"You can either have the Le Baron convertible or upgrade to a full-size at five extra dollars a day," he said bluntly, the smile draining from his face. I took the convertible.

"Fine," he said tap-dancing on the keyboard. "Now," he said with the smile returning, "what colour would you like?" Did I hear this right? "Colour?" I said incredulously. "Do you mean you can't offer me a fuel-efficient sub-compact but you can offer me a gas guzzling convertible in the colour of my choice?"

His smile packed it in. "Red, white or blue?" he said in a fast foods way.

Out on the ubiquitous California highway in my gleaming, almost vestal, virgin-white convertible, it was a top down kinda day. Cool breezy scenes with cool breezy jazz blaring out of four fine speakers. The car drove like the tank that it was, but what a music system... American auto designers certainly have their priorities right. And when the weather got just a little too cool, I turned the Satan-mobile heaters from Hell on full-tilt and added another degree to global warming.

Did I feel guilty? You bet – imagine the family shame when two generations hence, scientists trace the world's

weather catastrophes to the mobile furnace of one top-down convertible in 1992 driven by an indulgent journalist.

I was, however, on a mission from God. Well, maybe not the capital "G" god, but one of the minor stand-ins. Aeolus – god of wind. I was on my way to the altar of Altamont – a shrine to those who believe that the cure for our fossil fuel and nuclear energy addictions is blowin' in the breeze.

Altamont Pass is to renewable energy advocates what Mecca is to Muslims or what the mythical 'free-market' is to an economic rationalist. Unlike the free-market, however, Altamont does exist.

California has always provided the quintessential paradox of American ethics and politics. On ubiquitous monoxide freeways, punctuated with solar-powered emergency phone boxes, we cruised through the nuclear playground of Livermore and out of the suburban cancer, which has so radically consumed most of California, to the altar of Altamont.

There, sprouting like spring wildflowers on the emerald fields of California's windiest pass, some 7,000 wind machines whirled in Tibetan prayer-wheel symmetry, offering energy alms and electrical homage to the greatest of Californian gods – the consumer.

No humming, chanting Buddhist monks here, just the whirring, whooshing of wind pushing past 25m blades and the bestial burring of copper coil with magnet. At a distance of a kilometre, however, the sound retreated to just the song of the Pacific-driven wind.

The owners of the land, ranchers who previously fed the lush hills to future Big Macs, have become the new energy barons – making plenty of hay, both agricultural and monetary, from the dual use of the land. In just a decade, their new 'wind farms' have a hard and dynamic economic reality.

Anyway, the cows didn't seem to mind. They stood chewing cud in rough harmony with the sweeping blades on a breezy, flatulent afternoon while nonchalantly plopping organic frisbees all over orange poppies. Whoosh. Whoosh. Plop plop. Burr... It was a strange Zappa-like percussion.

Like some past sermon on the alta-mount, I began to remember: "Power to meet needs of 100,000 homes, \$2 billion investment, thousands of jobs, minimal pollution". Hard facts, high technology, economic reality – the gospel according to Wall Street.

My friend simply smiled at the horizon and said, "It's beautiful". Beautiful? Now there's a word that you don't hear in the same breath as 'power plants' these days, certainly not of the nuclear or smoke-belching coal varieties.

Back on the sashayed streets of San Francisco, sans Satan-mobile and at the famous rainbow-littered corner of Haight and Ashbury, I tossed a buck into the hat of a blues-belting busker with a special request. You guessed it: "The answer is blowin' in the wind". ●





FORTY-TWO

DAVID DALE

The great advantage of the desktop computer, according to author Douglas Adams, is that it has provided writers with a whole new way of wasting time when they are supposed to be working.



David Dale's last column for 21•C was on Stan Lee and Marvel Comics.

Over the past 15 years, Adams has produced four volumes in what he calls *The Hitchhiker's Guide to the Galaxy* "trilogy", and he's currently working on a fifth, entitled *Mostly Harmless*, due to appear later this year if he finishes it. But he's an expert in finding reasons to put off the process of writing.

"Writers are great ones for displacement activity," he says. "It used to be that when you had something to write, you'd go out and buy a new notebook, and sharpen all your pencils, and you'd start cleaning your fridge. When you start cleaning your fridge you become obsessed with some of the things you find in it. You spend all day going up and down seeing if the things in the fridge are all right.

"With me, it was baths. I'd get up in the morning ready to get to work and go straight to the bath. And I'd lie in the bath until I had a good idea.

"Now all that has fundamentally changed. Now if you're a writer, you spend all day reconfiguring your operating system. I'm never happier than when I can spend an entire day getting the computer to perform automatically tasks that might otherwise take a good 10 seconds to do by hand."

I encountered Douglas Adams at the 1992 convention of the American Booksellers Association in Los Angeles. He was among some 26,000 publishers, authors and shopkeepers who gather every year to preview, debate, buy and sell the latest trends in literature (if I may use a rather old-fashioned term). This year the trend analysts seemed to think that the moneymakers over the next 12 months would be about recovery from various sorts of addiction, or about menopause, since baby boomer women are entering their 40s, or about the reappearance of traditional family values to live by, or further theories on the JFK murder conspiracy, or advice to women on how to get rid of oppressive men. Having established that, we just need to hire a few hacks with computers to throw something together on those subjects, and we'll make a fortune.

But there'd be no point in hiring Douglas Adams to generate a bestseller by formula, even if he does have his own computer. Adams managed to bemuse the American booksellers and publishers, because they tend to discuss books as products, able to be planned, packaged and marketed much like hair shampoo or frozen foods. Adams confronted them with the quaint idea that books can be the result of creative effort by individuals.

The four volumes in his trilogy have sold spectacularly in Britain and Australia, but not quite so well in America. There may be a difference in the sense of humour, and this was certainly demonstrated when Adams tried to turn the *Hitchhiker* series into a film. An American producer had bought the rights to the first book, and had asked Adams to produce a script.

"I had a meeting with the producer in Los Angeles and it turned out that he had not actually read the book as such," says Adams. "You know, Hollywood people are busy and this is a good 156 pages. I had written a script that was reasonably faithful to the book, but a lot of it caught him completely by surprise.

"He said: 'There's some good stuff in here, and there's also some stuff that I'd like to talk to you about. For instance, you say that we're going to find out the answer to the ultimate question of life, the universe and everything. That sounds good, a lot of people want to know that kind of stuff, particularly here in California. So you build up a little tension, and we think we're going to find out, and you build it up and build it up, and then what do you do? You say the answer is 42. Well, I think the audience is going to feel really jerked off by that.'

Adams proudly declined to reveal the plot of his new *Hitchhikers'* adventure, although he did admit that, under the influence of violent bestsellers such as *The Silence of the Lambs*, he has inflicted sprained ankles on most of his characters.

A similar lack of precision was apparent in the responses of another author at the convention, David Barry, who is a columnist for several US newspapers. He said he was close to finishing a book about Japan, which sounds like a modern publisher's dream – a big analysis of what the Japanese are really like, what they want, and what they will do next. Just what every intelligent US reader is begging for. But Barry isn't quite what the packager ordered. When I asked him what he'd discovered, he said: "My original goal was to have lots of deep insights about Japan, but soon after I arrived there, my goal switched to finding any food outside the hotel after breakfast that didn't have tentacles in it."

And what can we learn from Japanese industry? I asked. Barry has the answer: "When they make things, they have these robots and no people hardly anywhere. We don't need anything from the Japanese. We don't need their ethics. We just need those robots. We should just go over there, chloroform them, and bring them back."

But do the Japanese want to own the world? "I didn't try to focus on the 'we're paranoid about them owning the world' aspect," said Barry. "But if they do, they probably earned it, because they work much, much harder than we do. There's never a problem with anything. Everything works, the service is incredible, and you don't tip anybody. I would say the only advice I would give them is it wouldn't hurt if they lightened up a bit. They're not exactly a wacka wacka

kind of nation. Whereas we're a lot more fun. We're not necessarily good at anything, but we're fun."

Dave Barry is an author who writes what seems funny to him at the time, but increasingly, he doesn't fit any of the categories that the publishing industry would like to define, and he may be a vanishing species.

Fortunately, there were other authors holding the flag of individuality at the convention – Michael Dorris, for example, who is half American Indian by birth, but who defies classification into the native American genre that has become fashionable since the film *Dances with Wolves*.

Dorris confessed that as an American Indian he feels "a bit of a multicultural washout. As I was growing up, I rarely encountered native American fictional characters with whom I could identify," he said. "They were all for instance, too damn nice. They seemed more often than not endowed with quasi-magical powers that allowed them to sense events in advance or to communicate telepathically with various animals or birds.

"The native peoples I read about in books, and believe me I scoured the library, always seemed to be engaged in performing rather dull crafts, sort of like earnest boy scouts, or alternatively they rode about bareback on ponies, whooping it up. In short they weren't like anybody I knew and I didn't particularly think in actuality I'd get along with them very well, or vice versa. The Indians I knew were neither noble nor savage most of the time. They had no natural sense of direction, they dressed in regular clothes, they didn't talk constantly in poetic metaphor and they tended to laugh a lot, to make jokes whenever possible, even when things weren't going their way – especially then."

Dorris has written a book about Christopher Columbus but nothing like the celebratory tomes that are appearing in this anniversary year. His novel, called *Morning Girl*, is about the first Indian encountered by the European explorers – a young girl Columbus mentioned briefly in his diaries. She was a member of the Taino, a tribe who died out within two generations of meeting the bacteria from the Old World.

"The Taino's experience was, in the extreme case, a precursor and a precedent for what happened to native peoples throughout the Western hemisphere over the past 500 years. So I thought in this year of birthday parties and celebrations of discovery, they, as the first to say hullo, deserved at least an imagined voice, a whisper that suggested they were more than just a passing welcome wagon on its way to the happy hunting ground."

Michael Dorris' small literary voice may well be drowned by what he calls "the booming instruments of quincentenary self-congratulation", just as Barry's parodies of our Japanese stereotypes and Adams' philosophical somersaults may pass over the heads of booksellers brainwashed by mass marketing. But authors like them are beacons of hope in a world that grows ever more standardised.

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LIVE AND LET DI: ETHICS AND JOURNALISM

BARRY JONES

The issues of privacy and the right to know are difficult ones, but journalists must not let their ambitions or sensationalist tendencies blind them to what is right.



Barry Jones' last column for 21•C was on our ageing society.

A very powerful and disturbing analysis of journalistic ethics is found in the book *The Journalist and the Murderer* by Janet Malcolm. Malcolm is one of the distinguished writers for *The New Yorker* and this book originally appeared, over several weeks, in the magazine. Malcolm first attracted attention with her books *Psychoanalysis: The Impossible Profession* and *In the Freud Archives*, an extraordinarily penetrating analysis of the schisms among the followers of Sigmund Freud, especially the role of Jeffrey Masson, a scholar turned investigator who gained access to the archives on the basis that he was a true believer, and then (from the point of view of the hard-core Freudians) turned nasty, revealing details of material that he had only been allowed to see on the grounds that he would only use his insider status to advance the cause.

The Journalist and the Murderer pursues a similar theme. It describes a bitter legal action in California, MacDonald v. McGinness (1987). Dr Jeffrey MacDonald was a convicted murderer, a doctor of medicine who was tried some years after the event for having murdered his wife and two children in North Carolina in 1970. In 1979 he was tried, convicted and sentenced to life imprisonment.

Joe McGinness was a reporter who first achieved recognition with *The Selling of the President* (1968), an account of Richard Nixon's successful campaign against Hubert Humphrey – an insider's description of the selling/packaging process involved in campaigning (especially on television). We are used to such revelations now, but in 1968 they had some shock effect.

MacDonald needed money for his trial and expressed interest in collaborating on a book. Indeed he had approached the author Joseph Wambaugh even before he had been indicted.

McGinness approached MacDonald, made a contract, was admitted to insider status in the defence team, became a confidant of MacDonald and attended the trial. When MacDonald was convicted, McGinness' letters to him indicate shock and dismay. He then wrote *Fatal Vision*, an account of the trial published in 1984, which declared his conviction that MacDonald was guilty as charged and a pathological personality.

MacDonald, by now transferred to a prison in California, sued McGinness for breach of contract and fraud. The trial (in 1987) led to a hung jury (although most supported MacDonald, not the author). Ultimately there was a settlement and MacDonald received \$250,000 damages.

Of course, when Janet Malcolm came to write her book, she too found herself in a similar moral dilemma that McGinness had been in. The whole inquisitorial process is a very complicated one (as Dostoevsky demonstrated so powerfully in *Crime and Punishment*) with an extraordinary symbiosis developing between inquisitor and inquisitee. The person being interrogated (especially if he/she has entered into it voluntarily) is flattered by the interest – and wants to believe in the interrogator's integrity. If the interrogator then says, either implicitly or explicitly, 'Go ahead. You can trust me', what are the moral implications?

It has been instructive to observe the recent feeding frenzy of the British newspapers, mostly the popular tabloids, but also the 'serious' *Sunday Times* over the matrimonial difficulties, real or exaggerated, of the Prince and Princess of Wales. These reports have been immensely damaging for the Royal family – as have the reports of the marriage break-up of the Duke and Duchess of York, the divorce of Princess Anne and concern about royal finances and whether the crown should retain its tax exempt status.

These papers, so prurient in their pursuit of the Royals, are (the *Sunday Times* aside) the same papers which defended Queen Elizabeth so passionately in February this year against what they regarded as the insults, not to mention physical assault, by the Australian Prime Minister.

The treatment of both sets of stories have only one element in common: a desire to sell papers. There is an absolute U-turn in the value systems which form the basis of the stories. Ethical factors seem of minimal significance.

There is a particularly poignant irony about the Princess Di phenomenon, especially because similar issues concerning public figures have been covered in the past.

These days we all expect to know most details concerning the health of our politicians. But before the age of television the situation was not so open. Many Americans didn't know that Franklin Roosevelt had polio or that Woodrow Wilson was frail and sick. In more closed societies, such as the USSR, the poor health of Yuri Andropov was concealed virtually until his death.

Prying into a politician's drinking habits has often had mixed results. Bob Hawke was not harmed by such revelations and may actually have had his popularity increased because of them. But, on the other hand, Edmund Muskie was forced to withdraw from the 1972 US presidential race after breaking down when questioned about his wife's drinking. (Harold Macmillan was once asked how to rebut such a claim. He thought "you should have seen her mother" would do the trick).

Journalists also have to be conscious of accepting material from a tainted source. It is very well to publish allegations but due care has to be taken about their credibility. Many questions were asked about *The Age* tapes concerning Lionel Murphy and their effect on his reputation.

The issues of privacy and the right to know are difficult ones but journalists must not let their ambitions or sensationalist tendencies blind them to what is right. ●

A University Faculty



The newest of Australia's 36 universities is Swinburne University of Technology, proclaimed on 1 July 1992. Since its establishment in 1908 as Melbourne's Eastern Suburbs Technical College, Swinburne has had a consistent educational mission of providing high quality, vocationally relevant education aimed at meeting the needs of the community it serves. Swinburne has responded to changing community needs by steadily increasing the breadth and depth of its offerings, resulting in its elevation to full University status. In July 1992 it was listed as one of the "10 best buys" for undergraduates by the leading annual guide to Australia's universities.

Like the rest of Australia, Swinburne must now respond to three major requirements: the need to **equal or exceed** world-best performance in many areas of community activity; the need to accept and take advantage of the high rates of social, economic and technological change that are likely to continue for many years; and the need to take advantage of the geographic, economic and political realities of Australia's location adjacent to South-East Asia.

To manage its way through the resulting long-term uncertainties, Swinburne's **Faculty of Business** (which has 85 full-time academic staff and over 2500 students, of whom over 600 are graduate students and about 350 come from other countries) has an evolving **corporate vision** that has been guiding its development over the past few years.

The Faculty's principal objective is to provide to its clients **high-quality educational and research services** relating to the effective operation and management of organisations in a rapidly changing environment. In pursuing this objective the Faculty is greatly assisted by its extensive network of links with industry and commerce and by four strategic priorities that encompass its corporate vision.

The first of these priorities is the need to be **flexible, innovative and responsive** to the needs of the community generally and of specific groups of clients. In the entrance requirements, content, and modes of delivery of courses, in the provision of special courses to meet special community needs, in research programs and in consultancy services offered, the Faculty strives to be as flexible as the resources and opportunities allow. Recent innovations include specialist degrees in Organisation Behaviour and in Business Information Technology, a sequence of linked graduate programs in Business Administration, and a very flexible and broad Bachelor degree.

The second priority is a strong commitment to **internationalism**. The eventual aim is to instil internationalism into our students as an attitude of mind, rather

than as solely a set of technical skills. Amongst the many activities introduced over the last four years are business-language-culture combined degrees, student exchange agreements with universities in other continents, and joint research with academics from other countries.

The third of the Faculty's strategic priorities is an emphasis on **technology**, in the broadest sense. Technology is critical to essentially all managers, as a practical tool for almost all businesses. In many cases it is also an essential part of the nature of the business, and in yet others it is a key part of the interaction between society at large and business - for example, in concerns about rapid technological change and about the environmental consequences of many technologies used in business. Managers must be aware of all these factors.

Lastly, the Faculty is committed to **people** and to excellence in their performance. Our concentrations on innovation, flexibility, technology and internationalism are not on the technical or mechanical aspects of these. Rather, our concern is, and must remain, on the interaction of these themes with the people who are our research clients, or our students who, after graduation, will make up the organisations that seek to survive and prosper into the Twenty-First Century.

Of course we cannot predict in any detail where these strategic priorities will lead the Faculty over the next decade. But with our clear strategic priorities focussed on future needs we expect that the Faculty - like the rest of Swinburne University - will continue to prosper and to serve the Victorian, Australian and world communities.

For further information about the Faculty, contact:

Dr Murray Frazer
Dean, Faculty of Business
Swinburne University of Technology
Melbourne, Australia

Tel: + 61 3 819 8078
Fax: + 61 3 818 3656





Asia: The Techno Neighbourhood

**Australia has the opportunity to
build a unique relationship with
its Asian neighbours, one that
combines government support
with private enterprise resources.**



Australia resides in one of the most economically dynamic regions in the world. Singapore, Malaysia, Indonesia, Korea, Thailand and Taiwan (the 'little Dragons' of South-east Asia) are among the fastest growing economies in the world. Although in their infancy, Vietnam is suggesting a potentially strong surge of economic activity and the indications are that, despite enormous difficulties, both the Philippines and Cambodia may prove to be economically powerful countries.

Indeed, from an Australian perspective some of the most dynamic economic partnerships are already underway. In areas of science and technology, major projects are yielding solid results. An example of this is the close relationship established between Australian and Philippines organisations in the field of marine geoscience.

These 'little Dragons' of South-east Asia have recognised the value of national science and technology

(S&T) production for long-term economic development and have become increasingly involved in the trend over the last five years for international co-operative S&T activities. Accordingly, Australia's northern neighbours are becoming increasingly important as potential partners in trade, industrial development and S&T collaboration, and may be central to Australia's economic future.

This has been recognised by Australian organisations: commonwealth departments, public research organisations, universities and private enterprise groups are developing or consolidating relationships with comparable organisations throughout Asia.

Many of these developments have been pursued independently of an overriding Australian governmental policy. Despite the substantial results, this approach has lacked cohesion towards the development and marketing of S&T to South-east Asia. ▶

KOREA

Australia's third largest trading partner, Korea, has dramatically increased its technological capacity and new organisations are being established within the country to introduce new technologies into industry. Korean firms and research organisations are strengthening international links for such acquisitions.

Australia can gain on several levels from working closely with Korea in the S&T field. The already substantial trading partnership can be broadened and collaboration with Korea could improve the technology development and commercialisation process in Australia.

There are major hurdles to overcome before such partnerships can be fully developed. At present Australia has little cultural or commercial crossover with Korea and there are few firms currently collaborating in S&T. There has been little information crossover between the two countries, unlike the EC/Korean S&T co-operation which has been informed by a wide ranging assessment of potential interaction on both governmental and private enterprise levels. Work is underway however to establish long-term alliances between Korea and Australia in the S&T fields.

VIETNAM

Vietnam's strong needs for an S&T and development strategy will assist in alleviating its poverty and rebuilding its war-ravaged infrastructure. It will also assist in reshaping its cumbersome bureaucratic economy. Vietnam has been largely denied access to technology from the West in most fields and the ability to develop the technological capabilities, human resource and engineering skills that often result from the strategic transfer of technology. Low level domestic technology within Vietnam is reflected in its outdated, Soviet inspired heavy industry sector and its economic position as one of the world's 20 poorest nations. However, since 1986 the gains made and its reintegration into the world community have allowed Vietnam enormous opportunities to build the multilateral and bilateral links necessary to improve domestic S&T. It is a market that Australia is moving into with strong partnerships developing in S&T and other fields of trade.

Similarly, while besieged with problems of poverty and underdevelopment, the Philippines is another country where partnerships with Australian firms and research groups are yielding solid returns for both countries.

THAILAND

Over the last five years, the growth of S&T links between Thailand and Australia has grown dramatically and continues to do so. However the projects remain small scale. Research and development in Thailand is a small field, concentrated in the public sector with few links to industry. The areas of opportunity lie more in S&T related services: technical and engineering services; post-secondary education; and human resource development look to be the areas of greatest opportunity. Current



investigations are underway by such organisations as the Department of Industry, Technology and Commerce (DITAC), the Australian International Development Assistance Bureau (AIDAB) and Austrade to investigate projects in the areas of investment, research, aid and trade.

INDONESIA, MALAYSIA & TAIWAN

More than in other countries of the region, Indonesia, Malaysia and Taiwan give prominence to the role of S&T in their economic development strategies. Japan's economic success and its export-oriented manufacturing strategies have inspired considerable developments along these lines in these four countries.

Taiwan has developed a sophisticated structure where gaining access to and generating knowledge in high technology fields is vital in establishing competitive advantage at the premium end of the market. Malaysia, Indonesia and Thailand are developing industrially and technologically through the concurrent promotion of technology transfer and domestic S&T capabilities. They have similar developing economies and objectives towards pursuing bilateral and multilateral S&T relationship. The three are increasingly looking to S&T to fuel the engines of economic development. Taiwan on the other hand has been highly successful in building a national R&D structure and in attracting overseas educated

researchers. The country has a long-term commitment to improve its R&D and S&T development and enormous potential lies there for Australian and other international investors.

Strengthening Australia's S&T bilateral links with the target Asian countries has to be constructed in the context of those countries' increasing investment in technology acquisition and development of initiatives to expand regional co-operation in industry and S&T. It is essential to establish primarily economic relationships.

There is strong interest in many countries in developing co-operation in S&T projects. However experience in development and management of such projects is slim and restricted largely to the European scene. The continuing interplay between 'technoglobal' and 'technonational' (or in the European case 'technoregional') forces generate an enormous range of policies and activities. In the Asia-Pacific region private sector initiatives have been the primary mechanism of S&T co-operation while in Europe it has been official EC agreements which build the interactions between researchers and business enterprises.

Reflecting upon these experiences, Australia has the opportunity to build a unique relationship with its Asian neighbours, one that combines government support such as CSIRO and AIDAB with private enterprise resources. It is to be hoped that the Third ASEAN Science and Technology Week will go a long way towards fostering such mutually beneficial relationships.



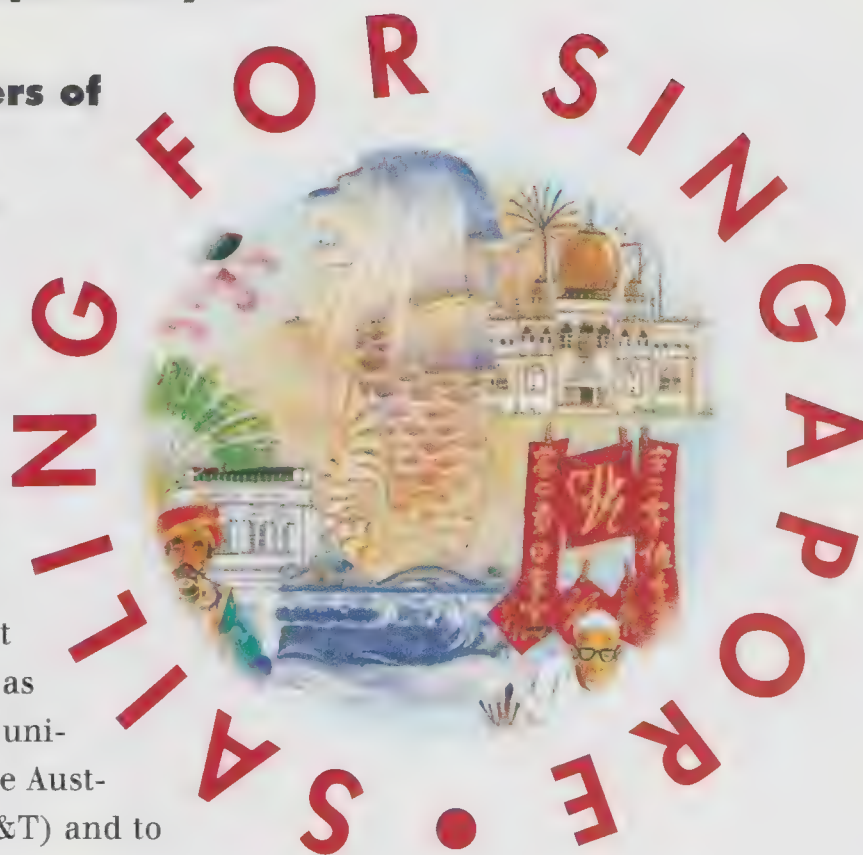
TASTW provides a unique opportunity for interaction between providers of hi-tech products & potential clients throughout Asia.

THE FORTHCOMING Third ASEAN Science and Technology Week (TASTW) in late September provides both a focus and a catalyst for Australian Government, as well as private sector and university institutions, to profile Australian science and technology (S&T) and to establish new relationships.

A triennial event, TASTW, hosted by the ASEAN Committee on Science and Technology, comprises conferences, seminars and exhibitions. It provides a unique opportunity for interaction between providers of hi-tech products and potential clients throughout Asia. Fortuitously from Australia's perspective, TASTW's priority areas closely parallel the project priorities of the Australian International Development Assistance Bureau's ASEAN-Australia Economic Co-operation Program (AAECP), an international development assistance program developed in collaboration with ASEAN's Committee on Science and Technology.

The inputs to the Australian pavilion at TASTW are being co-ordinated by four organisations already involved in the AAECP as managers to the co-operative projects funded by AIDAB. Australian Marine Science and Technology Limited (AMSAT), GASCOR, Australian Biotechnological Resources (ABR) and the Department of Industry, Technology and Commerce (DITAC) have drawn together companies and institutions at the leading edge of Australian developments in marine and environmental S&T, energy, biotechnology and information technology and communications (with an emphasis on microelectronics).

While individual companies will be able to profile their own unique products and skills, the dominating theme throughout the pavilion will be a co-operative approach to marketing Australian "products". The intent is to leave visitors to the exhibition with a feel for the extent and depth of Australia's expertise which is of immediate relevance to regional economic growth. ▶





Tidal current data collection is a crucial ongoing aspect of Australia's wide-ranging oceanographic research.

At the ASEAN Prime Ministerial Conference in Manila in July, Australia's Minister for Foreign Affairs and Trade, Senator Gareth Evans declared "one of ASEAN's greatest strengths is that it has never sought to go it alone". Co-operation he said is "deeply ingrained in the ASEAN collective psyche" and AAECF is "a particularly important area of current co-operation for Australia". The Australian participants at TASTW will be following that model and using the relationships developed through the AAECF as a key element of their push in the Asian marketplace.

Overall management of the pavilion is being undertaken by AMSAT, which acts as an export marketing consulting and project management arm for 12 federal government marine research, development and management agencies.



Processing marine seismic data.

AMSAT's membership includes divisions of the CSIRO, Bureau of Meteorology, Australian Maritime Safety Authority, Great Barrier Reef Marine Park Authority, Australian Institute of Marine Science, Defence Science and Techno-

logy Organisation and Australian Geological Survey Organisation (formerly the Bureau of Mineral Resources). The company offers consulting and management services ranging from resource assessment to complex ecosystem management, from computer modelling to ports' and harbours' operation.

In addition to representing and project managing the consulting services of its members in the international marketplace, AMSAT is also keen to encourage interaction between its organisations and Australian private sector interests in the development of consortium bids for international project work.

In 1991 Australian science and technology support by multilateral development banks totalled US\$165 million, a figure which the Minister for Trade and Overseas Development, John Kerin, said could double if indirect funding sources were included. "There is always room for expansion in this area," he said with reference to the Asian Pacific region, noting the role of Australia's membership of the Asian Development Bank and the World Bank in allowing opportunities for Australian business to compete for contracts in this market.

"We are particularly keen to assist Australian industry win contacts with clients such as the World and Asian Development Banks," said AMSAT's CEO, Bob Harriss. "Often an obvious link to Government can give a project bid an advantage when dealing in the Asia-Pacific region. We are looking to either joint venture in project work or to provide specialist expertise to supplement individual company bids. One of our primary objectives is to use our regional Government level relationships to support Australian industry.

Our involvement in TASTW with its guaranteed audience of ASEAN ministers and senior officials and in the AAECF

itself is a cornerstone of that strategy.

AMSAT presently manages the AAECF Marine Science Project and draws on expertise from its own constituents the Australian Institute of Marine Science National Tidal Facility and CSIRO Division of Oceanography. The program has two components: one examines the large scale oceanographic phenomena of the region, the regional ocean dynamics project (ROD); and the second the living coastal resources project (LCR) examines and monitors key coastal resources such as coral reefs and mangroves.

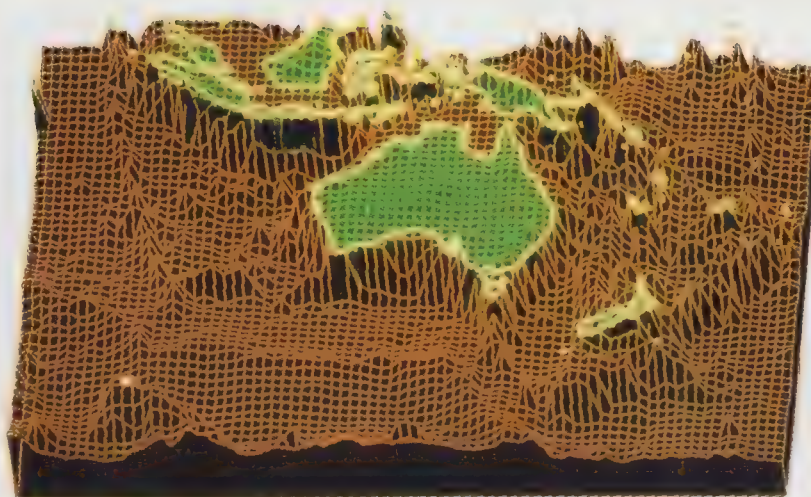
Professor Geof Lennon, director of the National Tidal Facility who as chief technical adviser has been involved in the ROD program since its inception in the late 1980s said, "initially the ASEAN request for a co-operative program was made with a view to gaining access to and experience with the technology required to observe and model regional tides and tidal phenomena, principally to assist in navigation and port operation. However our ASEAN colleagues have become increasingly aware that they are sitting on what is probably the prime oceanographic real estate in the world. They are in the largest shallow water sea on the threshold of two major oceans, and it's the site of a major current system which crosses the equator carrying heat from one latitude to another. If there is any variability in that current from one year to another then it is likely to trigger changes in the climate - like El Nino. One of the reasons we're having a dry winter this year is because we've had a mild El Nino," he says, also citing recent bush fires in South-east Asian rain-forests. "It really is a large scale phenomena."

Mr Kerin recently approved an expansion of the ROD program to enable a major investigation of the equatorial current systems to proceed, and Dr George Cresswell of CSIRO's Division of Oceanography will be co-chief scientist for this component of the expanded project.

He agrees with Professor Lennon that an improved understanding of the oceanography of the region is critical to better predictability of climate variability. This will allow policy makers and resource managers to develop strategies relevant to fisheries, agriculture and human health.

As the Earth's great heat reservoir, the ocean absorbs solar energy which is carried as heat in ocean currents then released into the atmosphere, perhaps thousands of kilometres away. This influences winds, rainfall patterns and temperatures. The ocean also absorbs much of the excess carbon-dioxide and other gases that contribute to the greenhouse effect. This capacity to distribute heat and gas has a profound influence on climate and is a key to predicting long-term climate changes.

Our ASEAN colleagues have become increasingly aware that they are sitting on what is probably the prime oceanographic real estate in the world.



Above: **Computer-modelled bathymetry of the seas around South East Asia, Australia and New Zealand.** Below: **Missionary Bay on Hinchinbrook Island - the enhancement of imagery data was done by a CSIRO MicroBRIAN imagery analysis work station.**



The nature and variability of the ocean's flow between the Pacific and Indian Oceans through the equatorial straits are considered the major unresolved questions in oceanography with global significance. It causes profound effects for the ASEAN and Australian region and other parts of the world, including droughts, floods and tropical cyclones. The equatorial, particularly Indonesian, through flow is one of the least studied and poorest understood parts, says Cresswell, who also notes that the project could not have been conceived and implemented without the co-operation of all the players in the AAECF Marine Science Project.

The LCR component of the Marine Sciences Project has been equally successful in contributing to an improved understanding of the resources of the coastal zones of ASEAN, information required to ensure sound management of these fragile systems.

Since its inception, the LCR project has emphasised the exchange of scientific and technological knowledge between ASEAN and Australian scientists,

with an emphasis on training young scientists. As well as exchanging knowledge, there has been considerable use of modern technology. Computers have been provided for the development of database expertise in each country, including the use of the Australian developed microBRIAN software system for the remote sensing of coastal resources.

One of the major outputs of the project has been the development of a manual of methods to monitor coastal resources. This manual has recently been adopted by the United Nations as the accepted global standard for such monitoring.

ASEAN scientists in the LCR project have amassed the world's largest regional database on the status of coastal resources; a database that will be invaluable in monitoring changes to marine resources, especially changes resulting

from human disturbance and global climate change caused by the increasing greenhouse effect.

The AMSAT agencies are now looking to build on the successes of both the LCR and ROD projects. By attracting World Bank support it will help expand the databases and infrastructure generated under the project into a network of ASEAN centres each capable of supporting the decision making processes for environmentally sustainable development of the coastal zone.

The specialist skills of AMSAT's agencies and the supercomputing capabilities of the National Resource Information Centre (also an AMSAT member) will all be brought to bear on this project design.

THE ASEAN-Australia Energy Project began in January 1990 as part of AAACP's Phase II. Its goal is to meet the energy needs of the region, support economic development and promote energy conservation. The Energy project, managed by GASCOR Consulting International and funded by AIDAB, also promotes, establishes and develops contacts between ASEAN and Australian energy workers. The Project has 14 sub-projects distributed across the ASEAN region and divided into three general components.

The Energy Conservation in Industry component has six projects investigating such areas as known energy saving initiatives and the development of new technologies including an Australian designed low cost hot water boiler which operates on low grade Thai lignite to provide heat for



A single Zircon crystal, about 1/5000mm long. The dating of such items (geochronology) is essential to the understanding of basin subsidence, sedimentation and sea level changes. Dating employed the SHRIMP (Sensitive High Resolution Ion Microprobe) technology at ANU.

the drying/curing processes.

Three projects incorporate the Energy Conservation in Buildings sector. Two projects involve building energy performance software (BUN-YIP) which will become a building code requirement in Singapore and the Philippines. The third applies a low face velocity air handler to air conditioning in tropical climates.

The third component, Fluidised bed combustion, has five projects constructing individual FBC units for the efficient and effective use of biomass wastes (e.g. rice husk, lowgrade

coal, wood waste) as an energy source.

An Australian co-ordinator monitors each component providing technical assistance and sources expertise and materials where possible from Australia. Although many sub-projects involve research into new areas, much of the Energy Project activity is in the application of known technology into new arenas. The emphasis is matching appropriate technology to equipment that will perform efficiently and is easily maintained and durable.

One of the major areas for Australian investment potential is biotechnology which has already established commercial partnerships with countries in the region. Australian Bio-



Cameras mounted on trawl gear assist in biological sampling.

Peptide Technology Limited

Peptide Technology Limited is the parent company of an international group of biotechnology companies operating in four countries, manufacturing and marketing new pharmaceuticals for human and animal health.

The Group has extensive experience in:

- ☐ Antibody Engineering.
- ☐ Bulk manufacturing of peptides.
- ☐ Vaccine technology.
- ☐ Taking promising laboratory compounds through to clinical trials.

Contact: Dr David Fisher
General Manager
P.O. Box 444
Dee Why, NSW, Australia
Tel: +61 (02) 981 3522



Above: The Peptide laboratories are testing a new treatment for Glaucoma, a major cause of blindness in people over 40. The group is also researching anti-viral therapies for AIDS.

technological Resources (ABR) is well placed as the main co-ordinating body for the Biotechnology aspect of the week, specialising in analysing both the financial and technical feasibility of existing or proposed biotechnology ventures. The group assists companies or organisations with marketable products in the biotech field by assessing the commercial potential of the product.

The organisation has an international database of more than 2,500 organisations, says Dr Greg Gibbons. ABR's database was chosen to form the basis for the World Bank's International Agricultural Biotechnology database, he says.

Also represented in Singapore is Peptide Technology Limited which regards its research in the fight against cancer as its greatest innovation. "The humanising of antibodies is one of the most exciting things we are doing," said Jan Edwards, supervisor of management services. "We have made antibodies in mice that look promising with regard to cancer. But we have to humanise them. Our British company (Cambridge Antibody Technology) has found a way of genetically engineering the antibodies." The aim is to remove the 'murine' effects (of mice) so humans won't suffer side effects.

Peptide in Australia is continuing this research which will soon reach clinical

trials. Ms Edwards said the company is going to the Singapore conference to make people aware of their research. "We are always looking for partners to commercialise our research. It helps pay for the high costs," she said.

The Australian Biotechnology Association (ABA), also going to Singapore, represents about 600 members involved in the research and manufacture of everything from seed production to diagnostics. Its role is to link industry with research carried out by the public sector.

Martin Playne, managing editor of the ABA journal *Australasian Biotechnology*, says that while many companies traditionally market themselves directly overseas, the ABA will try a collective approach at the Singapore conference. Some diagnostic and food companies already had a profile in Asia, and there is a very positive response to Australian research, according to Mr Playne.

Similarly, Dynavac Engineering believe the Asian market

to be ready for innovative products from Australia. Dynavac, which has worked to create unique world-class freeze drying machines and electron microscope preparation equipment, sees its commitment to the region as long-term. "Our policy is for sustained profitable growth in the ASEAN market," said Dynavac's Eric Dobbie.

Microelectronics is a technology that is rapidly changing the face of world-wide communications and information. Australian research in the

We have made antibodies in mice that look promising with regard to cancer. But we have to humanise them... so humans won't suffer side effects.



Dynavac's freeze drying technology for the preparation and storage of organic samples.

members in the field of advanced microelectronics design. It established a significant network amongst ASEAN and Australian institutions and began the process of introducing these skills to industry.

The second phase (1989-1994) focuses on developing and expanding ASEAN microelectronics design capability leading to joint ventures with Australian industry in product development, especially in the fields of telecommunications and industrial control systems. The project focuses on the development of microelectronics hardware and software for specific applications in ASEAN countries and giving them commercial applications. These range from the new and enhanced telephone exchange systems, telephone hand sets, native language displays for personal computers and data acquisition systems, to more complex technologies such as medical imaging, speech recognition and image processing.

The AAEC Microelectronics Project has been largely responsible for introducing the teaching of integrated circuit design using 'Very Large Scale Integration' techniques to tertiary institutions in ASEAN countries, making it possible for ASEAN designers to realise designs on silicon for the first time. This has led to the design of chips with commercial potential as well as the establishment of design bureaux to assist the local industry absorb and apply the technology.

A number of projects have advanced to a point where working prototypes have been produced and are currently being tested, including the Communicator for the Handicapped (Singapore), a voice mail system (Thailand), a telephone subscriber interface (Indonesia), a new word recognition system

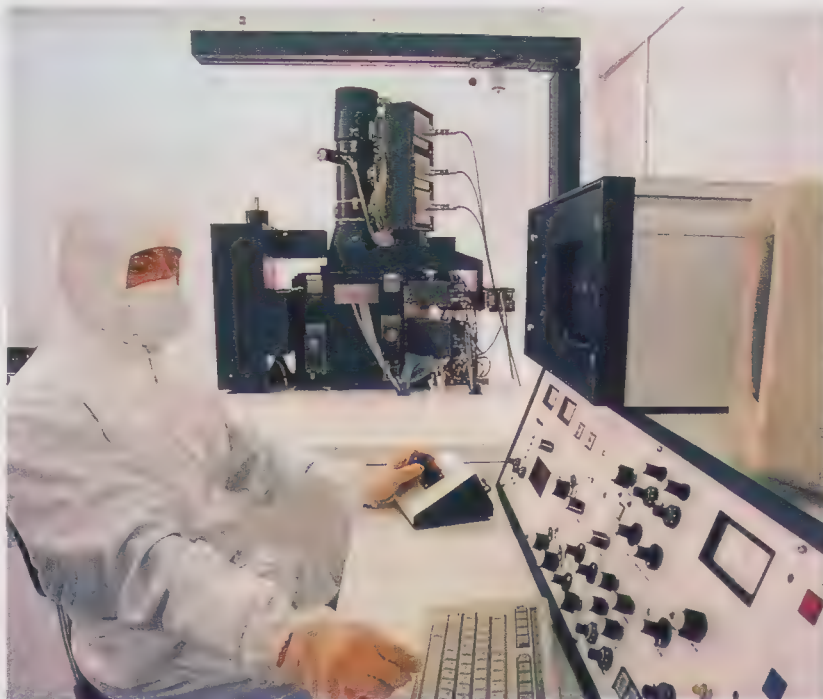
field is amongst the most sophisticated in the world. Its development has been a combination of the support of the Department of Industry, Technology and Commerce (DITAC) and the research and development of a number of government and private enterprise groups including AWA, Info One, Techsearch and AAP.

DITAC has maintained a close involvement with the AAEC Microelectronics Design and Application Project, starting from the initial phase of the project (1986-1989). This phase concentrated on enhancing the capabilities of the ASEAN

(Malaysia) and an electric motor controller (Philippines), all of which have potential world markets.

One system close to commercialisation is the Handicapped Communicator. The prototype of this system was first demonstrated in September, 1990, and has been redesigned with enhanced features. A number of these systems have been made available to centres for the handicapped both in ASEAN and in Australia for field trials. Small scale production is currently under negotiation. It has several features not available on current systems, including its ability to use unmodified low-cost personal computers.

One of the key successes of the project has been its integration into broader national and international programmes



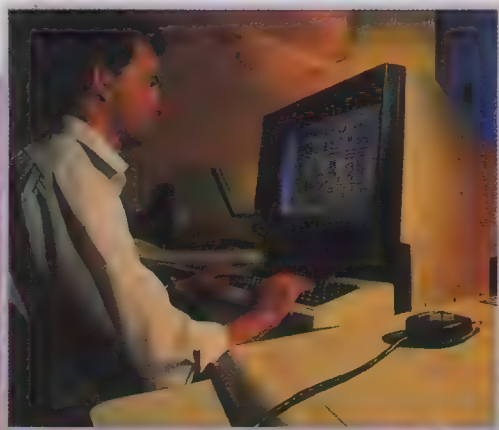
Microtechnology: an EBMF Electron Beam mask maker in operation at AWA.

and moves towards establishing connections between the skills developed and the needs of local industry. It has grown rapidly. In Indonesia the project is one of the main elements of a National Semiconductor Programme which involves seven of the key research, development and commercial agencies. In Thailand it falls within the national Electronics and Computer Technology Centre's programme. Such developments increase the resources available, so much so that

Microelectronics is rapidly changing the face of world-wide communications... and Australian research is amongst the most sophisticated in the world.

national contributions in terms of funds and in-kind support are estimated to be in excess of 10 times the AAEC contribution. This means that the access to Australian microelectronics technology provided under the AAEC project is an integral part of national development plans.

Close relationships have also been established with a UNESCO regional network on microelectronics, and a programme to support greater use of microelectronics technology in local



Circuit design using a schematic capture programme.

Oxidation of wafers and diffusion of impurities in 1000° furnaces.



Microelectronics component testing.



MICROELECTRONICS

industries. Both are drawing on developments from the AAECF project. It is the establishment of design bureaux in ASEAN countries that is the key to the project's success. The Microelectronics Design Bureau in Singapore commenced operations last year within the Ngee Ann Polytechnic which is investing money in equipment, personnel and training. The bureau is developing commercial relationships with the Singapore private sector and two Australian companies, AWA MicroElectronics Pty Ltd and CIMA Pty Ltd, will assist it in providing a commercial service.

AWA's microelectronics division in Australia is producing – and exporting – microchips with a huge range of applications from satellite voice and data communications systems through to processors able to detect, identify and track the most modern submarines. Their advertising for one specialist system stresses the potential of “rapid, accurate, passive target localisation” and is used by the Royal Australian Navy Sikorsky Sea Hawk helicopters.

At the other extreme from the military comes the cardiac defibrillator which ensures that the heart continues to function day and night. The defibrillator uses an ASIC (Application Specific Integrated Circuit), a part which is also found in the telephone.

The general manager of AWA MicroElectronics, Owen Hill, says the company proves that Australia could be a competitive microchip supplier: “Australian companies can be competitive in an area which has always been associated

with Japan and Silicon Valley,” he said.

Both organisers and participating groups are confident that TASTW will offer the opportunity to introduce some of the cutting-edge developments in Australian science and technology. It offers the strongest consolidated presentation of Australian know-how that the region has ever seen.

What is even more promising is that the commercial results may be every bit as exciting as the many scientific initiatives on display. ■

As microchip suppliers Australian companies can be competitive in an area which has always been associated with Japan and Silicon Valley.



COMPANY

Australian Marine Science and Technology Limited (AMSAT)

POSTAL ADDRESS

PO Box 341
CURTIN ACT 2605
AUSTRALIA

CONTACT

Mr Robert HARRISS
Chief Executive Officer

Telephone

+61-6-2818450

Facsimile

+61-6-2818436

AMSAT is an incorporated consortium of the 12 major Australian government marine science and technology institutions. The membership includes:



■ Australian Institute of Marine Science ■ Australian Maritime Safety Authority ■ Australian Oceanographic Data Centre
■ Bureau of Meteorology ■ Bureau of Mineral Resources, Geology and Geophysics ■ Bureau of Rural Resources ■ CSIRO – Division of Fisheries ■ CSIRO – Division of Oceanography ■ Defence Science and Technology Organisation ■ Great Barrier Reef Marine Park Authority
■ National Resource Information Centre ■ National Tidal Facility

These institutions have world class reputations, facilities and personnel and are committed to providing their services to the international market.

AMSAT was established to provide a single point of contact for the marketing of these services.

Services may be broadly grouped as:

■ assessment, use and management of marine resources ■ management and conservation of diverse ecosystems ■ coastal and offshore development ■ maritime operations.

COMPANY

Australian Maritime College (AMC)

POSTAL ADDRESS

PO Box 986
LAUNCESTON TAS 7250
AUSTRALIA

CONTACT

Mr John T FOSTER
Business Manager

Telephone

+61-003-260761

Facsimile

+61-003-263790



A comprehensive range of educational courses for the shipping and fishing industries. Through AMC Search Ltd, the College also provides consulting services in port design and development, ship handling, terminal operations, handling of hazardous cargoes, environmental studies, staff training, and many other areas. Its Ship Handling Simulator is one of the most advanced real-time simulators in the world and has been used extensively by Australian, New Zealand, Malaysian, Indonesian and Korean clients.

Packaged training programs that can be tailored to suit your individual needs include:

■ Tanker Safety, ■ Management ■ GMDSS ■ Survival at Sea
■ Fast Rescue Craft ■ Shipping Business ■ Computer Skills
■ Marine Engineering and Electronics ■ Ship Handling for Marine Pilots, and many more.

COMPANY

Australian Environment Management Export Corporation Ltd (AUSTEMEX)

POSTAL ADDRESS

GPO Box 5301
SYDNEY NSW 2001
AUSTRALIA

CONTACT

Mr Damien RYAN
Export Development Manager

Telephone

+61-2-3902714

Facsimile

+61-2-2513659

COMPANY

BHP

POSTAL ADDRESS

600 Bourke Street
MELBOURNE VIC 3000
AUSTRALIA

CONTACT

Mr Terry CHUAH
Manager
Business Development-
Environment

Telephone

+61-3-6093357

Facsimile

+61-3-6093814



BHP is a global resources and manufacturing company headquartered in Melbourne, Australia, with sales revenues of more than US \$12 billion and total employment of some 50,000 people; BHP is Australia's largest company.

Its three main business groups – BHP Minerals, BHP Steel and BHP Petroleum are strong and significant companies in their own rights. Created to service the main businesses and external clients are BHP Research, Engineering, Transport and Information Technology.

Contributing to BHP's success is a strong multidisciplinary technological base. By leveraging off its traditional process engineering capabilities and project management skills, BHP is able to offer a range of environmental services, particularly in waste water treatment and sludge disposal.

COMPANY

Collaborative Information Technology Research Institute (CITRI)

POSTAL ADDRESS

723 Swanston Street
CARLTON VIC 3053
AUSTRALIA

CONTACT

Prof Peter POOLE
Chief Executive Officer

Telephone

+61-3-2822400

Facsimile

+61-3-2822444



CITRI, the Collaborative Information Technology Research Institute has outstanding research laboratories and excellent computing facilities to support research and development activities. Collaborative research programs are conducted with national and international companies.

Technologies and Products include:

■ Hypermedia Database Systems ■ Intelligent Database Systems
■ Object Recognition Systems ■ Computer-Aided Software Engineering Tools

Training and Education

CITRI provides staff, facilities and delivery platforms to teach: Carnegie Mellon University's software engineering course Postgraduate Programs leading to Masters and PhD awards.

COMPANY

Computational Fluid Mechanics International Pty Ltd (CFMI)

POSTAL ADDRESS

25 Huntingdon Drive
GLENALTA SA 5052
AUSTRALIA

CONTACT

Dr Garry D TONG
Director

Telephone

+61-8-2783448

Facsimile

+61-8-2783448

CFMI is a specialist contract research and project engineering firm in the area of environmental hydrodynamics with over twenty years of experience including the modelling of the Venice Lagoon, Italy and Sydney's three deepwater ocean outfalls.

CFMI offers a range of state-of-the-art models for understanding the hydrodynamic impact of engineering works on estuarine and coastal waters.



COMPANY

GeoVision Australia Pty Ltd

POSTAL ADDRESS

Suite 403
165 Walker Street
NORTH SYDNEY NSW 2060
AUSTRALIA

CONTACT

Mr John McHUGH

Telephone

+61-2-9593310

Facsimile

+61-2-9594885



GeoVision has been a leader of Geographic Information Systems (GIS) since the 1970's, well-known for its leadership in open systems technologies and data base management for geographic information. With customers in 16 different countries ranging from telephone companies to utilities to large government and defence agencies and commercial enterprises, GeoVision's reputation is based on a high standard of technological excellence and innovation, with commitment to open systems architecture principles.

GeoVision's all-relational system architecture, representing the most open and advanced GIS data base architecture ever developed, will propel GIS into mainstream information systems technologies by embracing all of the critical elements of data access, distribution, and integration.

COMPANY

The Institution of Engineers, Australia

POSTAL ADDRESS

Engineering House
11 National Circuit
BARTON ACT 2600
AUSTRALIA

CONTACT

Mr Peter MAY
Executive Officer - Civil
College

Telephone

+61-6-2706555

Facsimile

+61-6-2731488



The Institution of Engineers, Australia represents all branches of the engineering profession in Australia. As such, it is one of the few engineering bodies in the world able to speak with one voice for the whole profession. Its breadth of expertise in applied technology enables it to make public comment and give advice to government in many areas.

The Institution promotes and advances the science and practice of engineering in all its branches, ensuring that the community is well served by the profession. In addition, the Institution encourages the development of Australia's technological capacity in a way that maximises its contribution to the economic growth of the Nation.

COMPANY

MPA Communications Pty Ltd

POSTAL ADDRESS

51 Lusher Road
CROYDON VIC 3136
AUSTRALIA

CONTACT

Mr Hal SHUSTER
International Marketing
Manager

Telephone

+61-3-7244488

Facsimile

+61-3-7244455



MPA Communications specialises in PC based image processing software for remotely sensed data including MicroBRIAN which grew from the needs of resource scientists for access to the tools of image processing. MicroBRIAN now enjoys day to day use in many countries throughout the world with applications including geology, forestry, agriculture, land degradation, water resource management, disaster monitoring, marine and coastal zone monitoring and environmental monitoring.

COMPANY

Mapping & Monitoring Technology Pty Ltd. (MMT)

POSTAL ADDRESS

37 Tully Street
SOUTH TOWNSVILLE QLD
4810
AUSTRALIA

CONTACT

Dr Debbie KUCHLER

Telephone

+61-77-716622

Facsimile

+61-77-716626



Mapping & Monitoring Technology Pty Ltd (MMT) specialises in manufacturing "Made-To-Order" maps using remotely sensed imagery as a base.

The assessment, purchase, processing and quality controlling of the remotely sensed image products is all conducted at MMT.

Remotely sensed and GIS data and systems are used simultaneously to construct a final image base map product.

A large segment of MMT's manufacturing procedures are often used in training and educating institutions in SE Asia and Australia in the fields of Remote Sensing and GIS.

MMT has extensive credentials in these regions.

COMPANY

VIPAC Engineers and Scientists

POSTAL ADDRESS

Mendel Building #02-02
12 Science Park Drive
Singapore Science Park
SINGAPORE

CONTACT

Mr Ian G JONES
Managing Director - Asia

Telephone

+65-7776033

Facsimile

+65-7792300



Vipac Engineers and Scientists is a well-respected consulting services company operating in Singapore, Hong Kong, Kuala Lumpur, Bangkok and all Australian states.

Vipac has considerable expertise in the fields of marine and off-shore consulting, underwater acoustics, development of specialised software for applications of airborne, structureborne and waterborne noise paths, including the noise component of the Sydney Third Runway Environmental Impact Statement, air pollution dispersion studies, energy optimisation and labelling of consumer appliances. Vipac has a significant Asian outlook, with regional headquarters and research laboratories in Singapore, and looks forward to its continued association with this dynamic region.

COMPANY

Yeo-Kal Electronics Pty Ltd

POSTAL ADDRESS

7/150 Old Pittwater Road
BROOKVALE NSW 2100
AUSTRALIA

CONTACT

Mr Geoff YEOMANS
Director

Telephone

+61-2-9392616

Facsimile

+61-2-9051100



Yeo-Kal Electronics Pty Ltd manufactures water quality monitoring instruments, including laboratory salinometers, data loggers and hand-held units.

Parameters measured include conductivity, salinity, temperature, depth, dissolved oxygen, pH, turbidity, percentage light transmission, quantum light and fluorescence.

Our company supplies products to Governments throughout Australia, as well as exporting throughout Asia and the world. Yeo-Kal's product range has become the preferred instrumentation for measuring water quality within Australia for many Government departments such as Environmental Protection Authorities, Water Boards, Water Resources and CSIRO.

Yeo-Kal has a total commitment to quality and new product development. Our range of products are reliable with long term stability and accuracy, while maintaining robustness for field operation.

WATER & ENVIRONMENT

**COMPANY**

AAP Communication
Services Pty Ltd

POSTAL ADDRESS

PO Box 54
GLEBE NSW 2037
AUSTRALIA

CONTACT

Colin McDONALD
Marketing Development
Manager
Advanced Systems

Telephone
+61-2-6921017
Facsimile
+61-2-6921042



AAP Communication Services Pty Ltd brings unprecedented experience and resources to meeting the specialist communications needs of Government, Business, Industry and Commerce.

Video-Conferencing, Voice Information Processing, Satellite and Microwave systems – these are some of the key new telecommunications technologies which AAP Communications Services offers under distribution agreements with world market leaders the OCTEL Corporation, Picturitel Corporation and Hughes Satellite Systems of the United States. These services are backed by a strong, nation-wide network of technical support, which also extends to third party maintenance agreements for computers and communications equipment and business cabling installation facilities.

AAP Communication Services offers communications network solutions for business and government, covering design, sourcing, installation and maintenance of telecommunications systems tailored to specific needs.

COMPANY

AWA MicroElectronics Pty Ltd

POSTAL ADDRESS

8 Australia Avenue
Australia House
HOMEBUSH NSW
AUSTRALIA

CONTACT

John HANN
Business Development
Engineer

Telephone
+61-2-7634111
Facsimile
+61-2-7461501

AWA MicroElectronics AWA MicroElectronics is part of AWA Ltd,

Australia's largest electronics company with a turnover of approximately \$400 million. AWA Ltd is totally Australian owned.

AWA MicroElectronics invested \$35 million dollars in a state-of-the-art semiconductor facility which has integrated circuit design, fabrication, assembly and test, to provide an infrastructure that helps companies to turn innovations into reality. The facility in turn forms part of the massive AWA manufacturing and engineering resource.

The company is small enough to be willing to approach opportunities with a flexible "What If" attitude, yet can draw on the large resources of the AWA Group.

COMPANY

CIMA Electronics Pty Ltd

POSTAL ADDRESS

51 Chapman Street
BLACKBURN NORTH VIC
3130
AUSTRALIA

CONTACT

Rick A HOCKING
Manager
Business Development

Telephone
+61-3-8986744
Facsimile
+61-3-8996004



CIMA Electronics is a high technology Australian company specialising in electronic design and development, manufacture and technology transfer. CIMA provides the following services to all industries utilising advanced electronics in product and systems development, especially for industrial electronics, communications and microprocessor based information products and systems.

Services offered are:

- Surface mount assembly & manufacture of products
- Design, development and production of Application Specific Integrated Circuits (ASICs), usually for surface mount assembly
- Design and development of digital and analogue electronics incorporating latest technology available
- Technology transfer workshop and seminars

COMPANY

INFO-ONE
International Pty Ltd

POSTAL ADDRESS

Level 3
2 Elizabeth Plaza
NORTH SYDNEY NSW 2060
AUSTRALIA

CONTACT

Anne-Marie DAY
Marketing Manager

Telephone
+61-2-9595075
Facsimile
+61-2-9295127



INFO-ONE International is a privately owned Australian corporation whose mission statement is to provide cost effective and readily accessible electronic information services.

INFO-ONE specialises in the design and development of CD-ROM products for both private and public enterprise. Our services allow information to be captured, stored, retrieved and distributed in the most efficient way. Particular emphasis is placed on providing users with a consistent and user friendly interface to access and manipulate their information from either a CD-ROM or ONLINE system. Specific types of applications produced by INFO-ONE include:

- Full Text Retrieval (Both CD-ROM and ONLINE)
- Archival/Data Storage
- Bibliographic and Library Systems
- Multi-media Applications

COMPANY

University of South Australia
TECHSEARCH Pty Ltd

POSTAL ADDRESS

PO Box 1,
INGLE FARM SA 5098
AUSTRALIA

CONTACT

D HARRIS
Manager, SSEG

Telephone
+61-8-3023301
+61-8-3023369
Facsimile
+61-8-3023384

**Sensor Science and Engineering Group (SSEG)**

- Expert Systems development unit for measurement systems
 - Physiotherapy Standing Balance Machine
 - Artificial Intelligence software tools for support of measurement system design – Specriter; ThermoShell; MINDS
- Centre for Laser Opto-Electronics (CLOE)**
- OPTICA – for constructing optics and mechanical platforms
 - CONCEPTA – educational software tool for constructing and running electro-mechanical and data acquisition systems
- Digital Communication Group (School of Electronic Engineering)**
- Mobile communications; Satellite communications; Signalprocessing
- Transport Systems Centre (TSC)**
- Multidisciplinary transport and logistics research group.



A U S T R A L I A N S I N A S E A N

COMPANY

GASCOR Consulting
International

POSTAL ADDRESS

1136 Nepean Highway
HIGHTT VIC 3190
AUSTRALIA

CONTACT

Mr SJ MAJOR
Manager
GASCOR, Energy

Telephone
+61-3-5566313
Facsimile
+61-3-5566377



Australian based GASCOR CONSULTING INTERNATIONAL is part of the Gas and Fuel Corporation of Victoria, the largest gas utility in the Southern Hemisphere. With substantial equity in private ownership, the Corporation returns an annual revenue of around \$A 1 billion.

Almost 1.2 million industrial, commercial and domestic consumers rely on the Corporation for the supply of reticulated natural gas. A further 170,000 consumers purchase liquefied petroleum gas from the Corporation either directly, or through a statewide network of independent dealers. In addition, the Corporation has extensive research and development facilities as well as on and off-shore exploration interests.

Established in 1981, GASCOR Consulting International has experience in all facets of pipeline design and construction, energy policy formation, feasibility studies, and energy management programs. With offices in Australia, Thailand and Singapore the consultancy has worked extensively throughout Asia and the South Pacific.

COMPANY

DATA Electronics (Aust) Pty Ltd

POSTAL ADDRESS

7 Seismic Court
ROWVILLE VIC 3178
AUSTRALIA

CONTACT

Tony SCHAUBLE
Director
Marketing

Telephone
+61-3-7648600
Facsimile
+61-3-7648997



Data Electronics is a research based manufacturing company specialising in microprocessor controlled data loggers.

Its success stems from the ability to design and manufacture innovative products which integrate sophisticated software with advanced hardware.

Since its inception the company has grown to become a major supplier of data logging equipment to the Australian and overseas markets. Over 50% of production is exported to clients in 25 countries. Data Electronics won both the 1988 Victorian Small Business Award (manufacturing section) and the Australian Small Business Award (overall section).

COMPANY

Industrial Process Controls Ltd

POSTAL ADDRESS

17 Queen Street
NUNAWADING VIC 3131
AUSTRALIA

CONTACT

John BLACK
Marketing Manager

Telephone
+61-3-8734200
Facsimile
+61-3-8732262



Industrial Process Controls has specialised for many years in the area of electronic monitoring and control of energy demand and consumption for industrial, commercial, and government facilities.

More than two hundred IPC energy management systems have been sold throughout Australia and New Zealand.

We have also provided revenue metering electronic Time of Use Registers to most of the electricity supply authorities in Australia over the last five years.

The Real Time Monitoring System (RTMS) is a natural extension of our involvement in energy control for manufacturing industry.

RTMS provides managers with accurate and timely statistics on machine performance, production schedules and productivity levels. It immediately flags problem areas, permitting instant remedial action.

More recently we have moved into the materials testing arena, and our road construction materials testing apparatus (MATTA) has achieved international acclaim.

COMPANY

Port-O-Kiln (Aust) Pty Ltd

POSTAL ADDRESS

63 Dandenong Street
DANDENONG VIC 3175
AUSTRALIA

CONTACT

Joseph DAVIS
Managing Director

Telephone
+61-3-7916799
Facsimile
+61-3-7911671



Port-O-Kiln is a specialist high-technology company which conceived a unique kiln in 1972, totally independent of any overseas technology, and since then has been expanding and developing their application.

At the forefront of kiln technology, super-efficient, low thermal mass, high temperature, oxidation/reduction Port-O-Kiln minimise consumption of "clean" LPG and natural gas fuels, reducing costs and "greenhouse" gas emissions.

They are easily transportable and may be firing product within 24 hours of delivery, with minimal installation and commissioning procedures. Operation is simplified allowing rapid training of operators. Electric power is unnecessary. Firing costs can compete with wood and tunnel kiln costs.

COMPANY

Branco Boilers & Engineering
Pty Ltd

POSTAL ADDRESS

PO Box 606
WODONGA VIC
AUSTRALIA

CONTACT

Rainer BRANDMEIER
Managing Director

Telephone
+61-60-244628
Facsimile
+61-60-562300



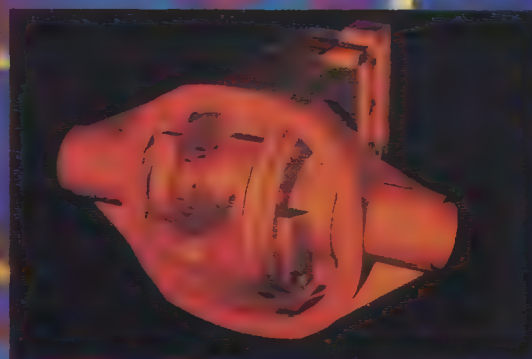
Manufacturers of:

- low grade fuel boilers ■ lignite coal, oil and gas (water type)
- tobacco curing units and crop driers ■ timber curing kilns.
- nursery plant heating equipment ■ hospital heating and hot water (not steam high temperature hot water).

industrial *magic*

From Terminators
to Volvos, high-end
computers are busy
making a killing in
Hollywood and saving
lives on the streets.

Wilson da Silva
takes a crash course
in supercomputing.



A phosphorescent-blue car with glowing grid markings slowly glides into view, then collides with a barrier. The front chassis crumples, shards of glass spiral in slow motion into the air and the metal body buckles and sways with the kinetic force of the impact. Crash test number 223; total number of cars written off - nil!

That's supercomputing. Whether it's simulating the chaos of clashing air masses over a city or designing a golf club that packs a more powerful drive, supercomputing is the application that is revolutionising the way industry develops products. It is also opening up a whole new era for weather and environmental effects forecasting that is far more accurate than existing methods, its proponents say.

Leading Australia's charge into this brave new synthetic world is the Warren Centre at the University of Sydney, which has been running a four-month project aimed at igniting supercomputer use in Australia. Some serious brainpower has been concentrating there in the past few months - not all of it human - to crack big engineering and environmental problems.

The heaviest hitters will not physically be there - they are five of the country's 10 supercomputers, which have been networked together with powerful workstations to create a number-crunching monster which will be applied as needed to problems. The electronic brains join 65 of the country's best and brightest minds in several fields, who have been meeting since late June led by Professor Greg McRae of the Massachusetts Institute of Technology (MIT).

"I really believe that the kinds of things we're talking about with high-performance computing could revolutionise industry and improve the economy in Australia," Professor McRae told a gathering of researchers and business executives at the opening of the project. "High performance computing can really change the way we do science, engineering and indeed business."

The MIT professor of chemical engineering left his native Australia in 1974, disillusioned and vowing never to return, but has since been impressed by the new spirit of innovation blossoming here. He is now helping the Warren Centre for Advanced Engineering get business, governments and academia to exploit the rich new opportunities supercomputers are opening up.

Supercomputers are machines that whirr at speeds greater than one gigaflop, or one billion floating-point operations, or calculations, per second. The most powerful run at a sustained 20 gigaflops, although some manufacturers say they can push their machines to peak at higher levels. There are also smaller "entry-level mini-supercomputers" with the open architecture and fast multiple-user capability of a full supercomputer but which run under one gigaflop, such as the Cray EL-YMP which manages 133 megaflops, or million floating-point operations a second.

There are also super-powerful workstations that mainly work at visualisation, and which were used to create the seemingly impossible metamorphic feats seen in films such as *Terminator 2* and *The Abyss*. These are a useful adjunct to supercomputers, interacting with them and visualising the results, or handling alone the smaller computational tasks that do not require the number-crunching muscle of a supercomputer. They are essentially one-person machines that cannot perform the multiple-tasking of a supercomputer, even though they are quickly approaching the crunching power of the "baby" supercomputers.

Collectively they are known as high performance computers, and their



Above: simulation of front end deformation during 80km/h collision.

Right: A Porsche being crash-tested the old way, a verticle drop.

Left: visualisation of a C₆₀ molecule called a Buckminsterfullerene.

Left inset: model of automotive part.



Supercomputers are machines that whirr at speeds greater than one gigaflop, or one billion calculations per second.

Below: the ribbons depict the separation of upward (orange) and downward (blue) moving air within a modelled severe storm.



The nation which most completely assimilates high-performance computing into its economy will very likely emerge as a dominant intellectual, economic and technological force of the next century.

application has mushroomed since the mid-1980s. Once seen solely as a tool for theoretical physicists to simulate the whirling vortices of distant galaxies, they are now used to design better beer cans on Earth. Pittsburgh's Aluminium Co. of America designs all its beer cans using supercomputers, a low-tech application that has nevertheless given them enormous cost savings in production.

Japan has leapt onto the bandwagon. From two supercomputers in the early 1980s, there are approximately 150 now, some 70 per cent run by industry of which 30 supercomputers alone are estimated to be used by finance companies for analysis and modelling.

In the US, big money is being spent in the field. Congress in November last year allocated \$822 million for 1992 as the first instalment of a five-year program to develop supercomputing, after being told returns on investment in the field can reach 50 to one. Introducing the legislation in the US Senate, Al Gore – since made the Democratic Party's vice-presidential nominee – said the field was vital to the country's competitive standing: "The nation which most completely assimilates high-performance computing into its economy will very likely emerge as the dominant intellectual, economic and technological force in the next century".

The White House has estimated the supercomputing program could almost triple the US's gross national product to \$628 billion in a decade! The potential is so huge and supercomputing so dominated by Japan and the US that Western Europe is getting nervous. A group of European scientists and industrialists, led by Italian Nobel Prize-winning physicist Carlo Rubbia, recently pressed the European Community to allocate a whopping \$9.2 billion to supercomputing research and development to catch up with Japan and the US. The EC currently spends some \$220 million a year on supercomputing, and accounts for about one-third of the world market for supercomputer purchases.

Professor McRae believes in the promise of the electronic super-brains, and is keen for Australia to get involved: "Everywhere you look in the business community, the finance community, the manufacturing community – in the US, Japan and Europe – you're seeing tremendous uptake of this technology," he said. "When I look here, I don't see that. It strikes me that it's absolutely critical for Australia's economic survival."

Supercomputers are applicable to a host of problems – modelling human genes, simulating and analysing complex weather systems like hurricanes, probing the structure and chemistry of the AIDS-causing Human Immunodeficiency Virus (HIV) or tracking and predicting global warming and ozone depletion. These are the so-called Grand Challenges that make supercomputer proponents starry-eyed.

But there are also the everyday problems the super-charged brains can tackle which are likely to make industry a buck and life easier for you and me – the sort of case studies the Warren Centre project is focusing on. General Motors Holden's is running crash simulations; Broken Hill Pty Co. Ltd is modelling continuous steel casting for its Newcastle operations; Pacific Power is developing models for power station furnace combustion; the Bureau of Meteorology and IBM Australia are improving forecasting of severe weather; Queensland's Department of Primary Industry is modelling droughts; the CSIRO and Victoria's Environmental Protection Authority are running air pollution models; and the New South Wales Water Board is designing oceanographic models of sea current flows around its deepwater sewerage outfalls.

The case studies are designed to show businesses and other potential users the practical and profitable benefits of supercomputing, by solving problems in their own industries. "Industry has got to be shown supercomputing is economically beneficial or they won't be involved," said Dr Robert Smith, general manager of the Warren Centre. "We've got 10 project teams and four months. Out of this project will come people from all areas of industry who realise what supercomputing can do for them in their field, and who know others they can collaborate with to solve their problems."

The promise of supercomputing for Australia is particularly good, say researchers. No-one is suggesting Australia should try to build supercomputers, or even parts of them – the key will be in using them to add value to the things Australian companies already do well, making firms more efficient and capable of delivering better quality products to the marketplace at a much faster rate than before.

"Canal building took off in the Middle Ages after the invention of the slide rule, but making slide rules was never a big industry," said Dr Bernard Pailthorpe, a senior lecturer in applied physics at Sydney. "We're good at ideas but we don't have lots of money or big computers. This field is tailor-made for Australia." Pailthorpe is a case in point. From his university office he has been running complex simulations on the San Diego Supercomputer Centre in the US which have led him and colleague Dr David Mackenzie to discover a new form of carbon amorphous diamond. They have developed a process for making thin sheets of the diamond from graphite sheets only 500 atoms thick which they believe will replace today's silicon computer chips and allow for a quantum leap in computing power.

It is the power of supercomputers for rapid experimentation and reduction of design time that make them such a potential goldmine for industry. Scientists agree many of today's complex problems can be tackled by a personal computer or a powerful workstation – but in today's competitive world, time is a big factor. Why risk millions of dollars and years of development to create a product using low-power computers when you can do it in weeks and beat your competitor to the market? "Lab experiments are in many cases very expensive, you mightn't be able to do them. With high-performance computing you can start to conduct a computational experiment – studying and exploring lots of different alternatives very, very quickly," Professor McRae said.

Apple Computer is a believer, and uses a Cray supercomputer to design its products: "We're really accelerating everything we do," said Richard Jordan, director of product design at Apple in the United States. "From the concept of the part to production of it. (Using a supercomputer) is the key to it, because we can cut five to 10 weeks off the design cycle. You've got the ability to find out – does this work? If it works, why? And can I apply it to other parts?"

Building new drugs by playing with chemical combinations inside a supercomputer is becoming popular. The world's largest pharmaceutical company, Merck & Co. of the US, in April bought a powerful Cray Y-MP 8I, the eleventh supercomputer to be bought world-wide for chemistry applications, and Cray says it has another 12 on order from the industry.

Supercomputers are also extensively used in weather forecasting and climate analysis, and the Bureau of Meteorology in Melbourne has two of the 21 supercomputers used for this around the world. World-wide, there are some 460 supercomputers, with Cray claiming 65 per cent of the market while the rest is shared between Fujitsu of Japan, Digital Equipment Corp. of the US and others. Outside of Japan, Cray claims to have supplied four out of five supercomputers, and many see Cray as the industry standard.



Above: the metamorphosing or 'morphing' of T-1000, the cyborg in "Terminator 2" was created by George Lucas' "Industrial Light & Magic" special effects team using powerful computer visualising techniques.

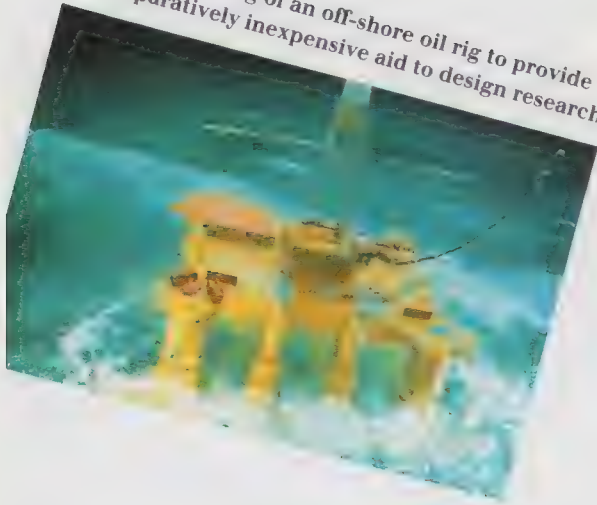
Below: NASA employs computer simulations to research aerodynamic flow patterns leading to improved aircraft and spacecraft design.



Right: a computer rendering to visualise the dynamics of fabric.



Below: rendering of an off-shore oil rig to provide a comparatively inexpensive aid to design research.



Below: currently the most powerful supercomputer system available is the Cray Y-MP C90. It is expected to be employed in tackling some of the most significant challenges facing science – like the prediction of global climate, the mapping of the human genome and the determination of molecular and other physical structures.



But supercomputers are expensive, making businesses weak-kneed about using them. They range in price from \$440,000 for the so-called “baby supercomputers” to \$38 million for the high-octane beasts. Its proponents say supercomputers are worth every cent for the competitive advantage they give firms, and the public benefit tasks they perform which could not otherwise have been done. They argue that the capital cost of supercomputing is coming down – it now costs about \$5,000 per gigaflop and is forecast to fall to a paltry \$38 per gigaflop by 2000. This is great news for cash-strapped Australia, but as one scientist put it, it also means supercomputing would soon be within reach of many of our competitors in the Asia-Pacific region and, without a lead established in the intervening years, Australia would be in trouble.

Supporters also argue that business is wasting resources by not using supercomputers, and a survey conducted by the CSIRO Division of Geomechanics’ Queensland Supercomputing Laboratories appears to back some of that up. The survey found that some \$95 million is spent annually by Australian businesses and research institutions on intensive computing to solve design and calculation problems. This was generally done on mainframe computers during off-peak times, or dedicated minicomputers and workstations running over many hours or days. Supercomputers would have been able to perform many of these tasks in minutes or even seconds, yet managers prefer to tie up expensive machines rather than make the leap to supercomputing.

Overseas at least, supercomputing in the corporate world has exploded since the mid-1980s, despite the cost, as automobile companies using them to design cars and aerospace firms found they could build efficiencies into the design of planes and parts. Boeing eliminated vortex turbulence in the slipstream of aircraft simply by toying with the shape of the aft wings, discovering in supercomputing tests that adding tiny winglets did the trick.

“Most major automobile companies, aerospace companies and pharmaceutical companies are using them,” said Pailthorpe. “Even if you can get return on investment of five-to-one, it’s worth it. A lot of guesswork in design is eliminated, and a lot of designing cannot be done any other way.”

The Warren Centre’s snaring of Professor McRae for the project is a coup. During the well-known chemical engi-

neer's tenure at Pittsburgh's Carnegie Mellon University, he built computer models showing what pollutants – from cars to lawn mowers – do to the air over the Los Angeles basin, leading to the US Environmental Protection Agency changes in air pollution laws, and the imposition of restrictions on the city's emissions. The same model is now being used to study air pollution over Mexico City, which has the world's worst case of air pollution.

The Warren Centre program is an attempt to help Australia catch up. Engineering company Goninans Ltd is using the \$1 million supercomputing laboratory set up for the project to design a railcar bogey capable of handling more weight and able to deal better with fatigue. Analysis of bogey design in the first run took 30 minutes, compared with 170 hours on the most powerful standard systems.

"You can stress it any way you want it and see where the metal takes the most strain," said aeronautic engineer Dr Grant Stephen, running a supercomputer simulation of the Goninans railcar bogey at the Sydney University lab. The bogey is cut into many grid parts, and the stresses on each grid analysed minutely, a technique known as fine element analysis. "Every time you design a new bogey, you don't have to build it and test it to see if your design was right," said Stephen. "With a supercomputer, you can do [the testing] then build a bogey that is going to be very close to what you want."

The Australian government is also being pressed to kick along development in the field, just as the US government is now doing. A recent report to Prime Minister Paul Keating's Science Council urged the establishment of a high-bandwidth network linking Australia with Asia "to collect data in any international location, deliver the data to Australia... use Australian-based skills and know-how together with high-performance computing packages and systems to add value to the data, and deliver the results back to the users at their international location".

These are the so-called 'data highways' now being funded in the US and considered essential to the harnessing of supercomputing's power for industry. Professor McRae compares the economic significance of these to the importance of roads and railway links to the early development of Australia. The expert group that prepared the report for Mr Keating said there was a multiplier effect associated with modest investments in high performance supercomputing, and called for between \$30 and \$45 million to be spent on the field, arguing that by 2000 "such infrastructure will be essential to be internationally competitive in research and development".

By all accounts, Mr Keating was impressed by what the group had to say. A week later he announced a shake-out of Labor's broadcasting policy aimed at allowing a faster introduction of optical fibre networks and limiting the monopoly of pay television to satellite delivery, a government policy that had been designed to enhance the selling price of the formerly state-owned Aussat to Optus Communications, but which the group said threatened to delay for years the widespread use of broadband optical networks.

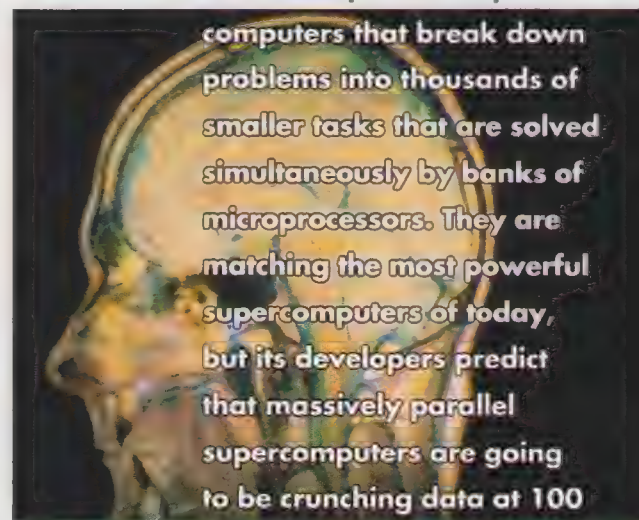
Should the government proceed with the recommendations of the report, the group forecasts Australian companies earning \$10 billion a year in information and technology exports by 2000. Talk to people in the field and there is an electricity in the air around them. They will tell you that computational engineering, as the field is known, is a radical change in science and engineering that will have ramifications in every facet of society. "We're visual creatures, the power of visualisation opens up whole new avenues for our understanding that piles of data can't," said Pailthorpe. "A supercomputer lets you convert data into something you can understand, you see it in motion in front of you. You gain insights you couldn't before." ■ Wilson da Silva's last article for 21•C was an interview with David Suzuki, 'The Wait of the World'.

Left: modelling of a projected electronic component layout.

Below: modelling of a section through a human skull and brain.

More Brains?

If you think the brain power of supercomputers now is mind-boggling, then consider the kind of power just around the corner. Researchers are producing the first of a new generation known as parallel supercomputers that break down problems into thousands of smaller tasks that are solved simultaneously by banks of microprocessors. They are matching the most powerful supercomputers of today, but its developers predict that massively parallel supercomputers are going to be crunching data at 100 gigaflops sometime in 1993, and within a few years approach one teraflop – one trillion floating point operations a second. This equals having 10 million personal computers simultaneously working on the one problem!



INVESTORS

B Y A N D R E W M A S T E R S O N

AUSTRALIAN RESEARCH AND INGENUITY CAN LAY CLAIM TO the development of television, the aircraft black box, the microwave oven and the colour photocopier, to name just a few Antipodean inventions. It doesn't stop there. The lights on the horizon range through HIV research, weather prediction technology set to save millions in dollars and thousands in lives, the ultimate electric battery and the cleanest cars yet!

The potential is rising for these, and other, research and development projects to extract enormous benefits for all Australians. And Australian investors are awakening to the opportunities.

PUTTING THE SQUEEZE ON THE PRIVATE SECTOR

Major Australian public research bodies such as the CSIRO, the Defence Science and Technology Organisation (DSTO), the Australian Nuclear Science and Technology Organisation (ANSTO), and others have been working towards or have achieved a 30 per cent private sector funding requirement. Not only has this attracted money from the private sector, it has also lent to a trend towards research based on industrial problem solving, as well as a number of successful joint ventures.

Recent years have also seen several other blendings of private and public research. In 1991, for instance, the Prime Minister's Department announced the formation of some 29 Co-operative Research Centres (CRCs), wherein industry, government research bodies and the universities combine on task-specific projects. Which brings us, in a round about sort of way, to sick chickens.

SICK CHICKENS, GENE SHEARS AND HIV

One of the low profile, but successful, R&D projects using both private and public funds is now close to completion. CSIRO and Australian veterinary manufacturer Arthur Webster Pty Ltd. have successfully combined forces to produce a genetically engineered vaccine to combat infectious bursal disease, a virus that costs the global chicken industry about \$50 million a year.

Arthur Webster contributed some \$600,000 into the project, which has resulted in one of the world's first genetically engineered single component viral vaccines. It will shortly go into commercial production, earning approximately \$5 million in annual export sales.

Genetic engineering, like computer science, is an area in which Australian R&D is achieving world-beating results (spurred, no doubt, by the economy's large agrarian industry).

Perhaps the greatest accomplishment in the field was the discovery in the late '80s by the CSIRO Division of Plant Industry of gene shears: molecules capable of altering genetic information within cells. Not only do gene shears have many potential applications in agriculture, they also represent a possible path towards a cure for Human Immuno-Deficiency Virus (HIV), the primary cause of AIDS.

In 1989, the CSIRO launched a multi-million dollar joint venture with Johnson & Johnson and French pharmaceutical giant Groupe Limagrain to develop the gene shears project further. The result, this year, was the construction of mini shears, or microzymes, a more stable and predictable refinement of the original discovery.

In uncharacteristically vernacular language, a recent CSIRO bulletin described the problem with the original gene shears

molecule: "It had a few extra bits hanging off it and tended to break up once it got inside a cell". In test tubes, at least, mini shears perform much more robustly, destroying the ribonucleic acid sequences of unwanted viruses. Progress continues, well in front of the rest of the world, towards incorporating mini shears into pharmaceuticals.

Another important genetic engineering project under way at the CSIRO involves work on salt-resistant trees. In combination with Alcoa of Australia, scientists are managing a project to use salt resistant strains as a way of combating soil salinity. Field trials are under way in the wheat

belt of Western Australia, and will shortly begin in Victoria's Murray-Darling Basin, where Greening Australia recently estimated 18 billion trees need to be planted by the year 2000 to maintain fertility.

While the CSIRO has been applying genetic engineering to poultry and trees, the DSTO has been considering its use on crustaceans. By definition, the DSTO's research is geared towards military problem solving, but several of its current projects promise civilian spin-offs.

The focus of one current DSTO project involves the vexing problem of what to do with the mounds of food-covered plastic bags that accumulate on board naval vessels while at sea. The answer lies in developing a radical new type of biodegradable plastic. And the key to that, according to the scientists, might just be a lobster. Crustaceans have an exoskeleton made of chitin, which is the second most abundant natural polymer after cellulose. In consultation with research teams in the United States, the UK and Canada, the DSTO is seeking to genetically-engineer chitin polymer to make it suitable for plastics

Not only do gene shears have many potential applications in agriculture, they also represent a possible path towards a cure for Human Immuno-Deficiency virus, the primary cause of AIDS.

WAKE!

Australia has a strong history of research and development, and private sector investment in this 'Aussie ingenuity' is growing.



manufacture. If successful, the resulting product will not only be biodegradable and shredable, but also edible to some forms of marine organism.

Many of the DSTO's current projects have a more hard-edged military intention. They include developing night radar for helicopters, microwave radar for surveillance, and advanced chemical weapons monitors. The organisation is also working on the application of virtual reality as a training method for soldiers. On another project, however, it has lent its considerable human-technology interface expertise to a primarily civilian research strategy being carried out by one of the Co-operative Research Centres, the Melbourne-based Centre for Intelligent Decision Making Systems (CIDS).

CIDS is a good example of a successful CRC, formed by an amalgam of 12 public authorities, universities and corporations, including the University of Melbourne, the Civil Aviation Authority and Carlton and United Breweries. As the name suggests, CIDS research centres on artificial intelligence appli-

calian-designed products, represents a major potential source of foreign exchange and influence.

WEATHERING HEIGHTS

The weatherman is a cursed figure. Predicting sunshine on the nightly news we are drenched the next day. Predicting arctic cold, viewers put on their warmest jumpers and sweat the following day away. But this tarnished image is about to change through new technology developed in Australia whose implications will save millions of lives and millions of dollars throughout the world community.

Glenn Wightwick of the Advanced Computing and Communications Institute, together with Dr Lance Leslie and Dr Greg Holland of the Bureau of Meteorology Research Centre in Melbourne are exploring the outer boundaries of weather prediction. This is being done by combining high level mathematics and Australian ingenuity with advanced computing and weather observing technology.

According to Wightwick, this technology is already in action: "Weather forecasting as a science has been interlinked with computer development in terms of the very fast computers needed to run the mathematical models". One of the first computer programs ever run was a weather model on the ENIAC computer at MIT in the USA in 1948.

Since then advances in computer technology have enabled amazing progress in observing and predicting the world weather. Twenty-four hours a day, seven days a week, computers linked in a global communications and computing network are gathering and exchanging observations taken from Bondi Beach to Barcelona. Dedicated weather satellites up to 36,000 km above the Earth are continuously monitoring weather systems from tropical cyclones to cold fronts.

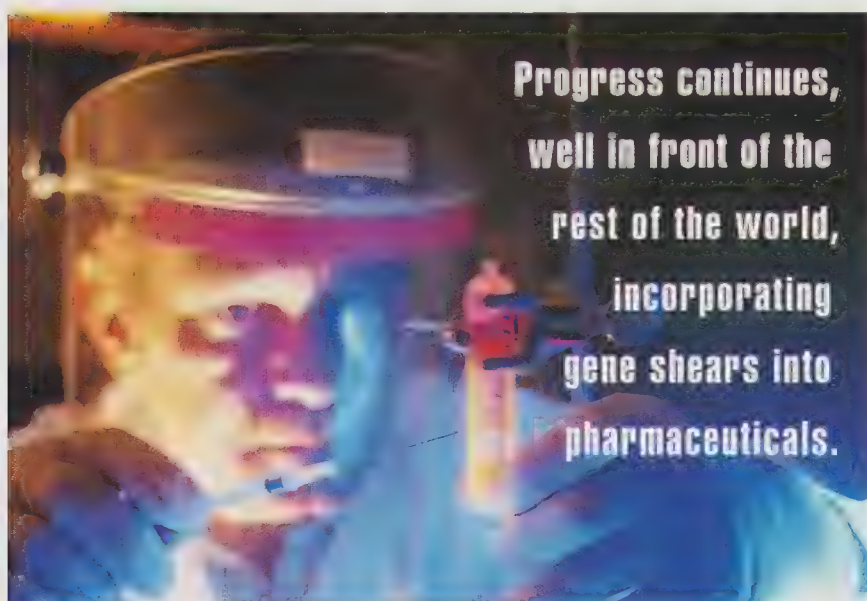
In the time it takes you to read this article, mathematical models of the atmosphere running on supercomputers will have assimilated these observations and made accurate predictions of the weather up to 10 days from now.

"The Bureau of Meteorology is an integral component of this network," says Dr Holland. "It's one of the three World Meteorological Centres – Washington, Moscow, and Melbourne – established under the World Meteorological Organisation (WMO)."

"The weather recognises no political boundaries," says Dr Leslie. "Today's weather in Fiji could have a direct impact on next months weather in Miami." As a result, the meteorological field is a model of international cooperation. Data and ideas are exchanged freely, regardless of political persuasions, to the benefit of all.

Computer developments are linked to advanced satellite observations, especially for coping with the enormous amounts of data involved. For example, a Japanese satellite located north of Papua New Guinea is sensitive to cloud brightness, which is converted to cloud top temperatures. Observations as close as one kilometre apart are taken over one-third of the globe every hour. "More data are collected from such satellites in one week than the number of words in all the books in existence when I was born," says Dr Leslie.

These data are converted by computers in Melbourne for use in the mathematical models. A global model provides the 'big picture' and exchanges forecasts with more specialised models that focus on specific regions, such as the Australian continent.



Gene shear research, CSIRO Plant Division.

cations in industry. One of its major projects is the development of OASIS: the Optimum Aircraft Sequencing Intelligence System. "OASIS is an inbound traffic control system for Sydney airport," explained Mr Rod Smith, operations manager for CIDS. It sequences inbound traffic by capturing it at the radar horizon – about 150 nautical miles out – and bears in mind factors such as wind speeds and direction, landing priorities and so on. It is geared to allowing the maximum possible number of landings, and hence take-offs, without having planes in holding patterns."

The OASIS system has been successfully tested in the laboratory. A prototype is now being installed at Mascot airport, where it will be tested running parallel to the existing system. Other CIDS projects include combat simulators and an artificial intelligence system designed to smooth bumps in Carlton and United Brewer's logistically complex production schedule. The range of projects undertaken by CRCs is broad indeed, including tissue research, Antarctic study, extractive metallurgy, and cochlear implant technology.

Industry-geared R&D may seem mundane and unexciting, but that makes it no less necessary. For every team working on life-changing technology such as virtual reality, for instance, there are half a dozen working on less glamorous projects such as industrial robotics or waste separation systems. The sale overseas of Australian-designed processes, as well as Aust-

For example, tropical cyclones are a major cause of devastation in Australia's north. Says Dr Holland, "There's enormous cost involved just for the preparations for the emergency". An inaccurate forecast can increase the problems to the community in terms of closing down businesses and schools. Wightwick adds, "If we can predict more accurately where it's going to hit, we can save a lot of inconvenience and cost to the community".

Often the Bureau develops the technology and networks the findings to various countries, organisations and governments. In 1989 the Bureau put together a workstation to predict tropical cyclone motion. It was selected by the WMO to be distributed to Third World countries. "We beat the US," says Dr Leslie.

The commercial applications of forecast improvements range much more widely, however, from fisheries, to gas projects off the north-west shelf of Australia, shipping and agriculture. The Sydney Swans football club are negotiating with the Bureau of Meteorology for specialised forecasts, and they did the forecasting for the America's Cup challenge in San Diego.

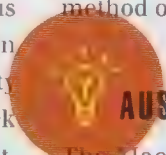
Australian research scientists are at the forefront of developing new methods of utilising the technological advances. Wightwick claims that the techniques being developed and practised in Melbourne are undoubtedly "at the leading edge". This leading-edge research is maintained on limited budgets and without full recognition of the world class results being obtained. Leslie points out that "many of the models around the world are derivatives of those developed here in Melbourne. It's quite amazing but it's true."

Research collaboration between the Australian Computing and Communications Institute and the Bureau of Meteorology Research Centre provides an example. Single computers are ultimately limited in their capacity, but linking many processors in parallel provides almost limitless possibilities. And this can be achieved at very low relative cost. Glenn Wightwick and Dr Leslie are working on the specialised techniques and innovations required to run mathematical models of the atmosphere in such a computer system. "The work we did 10 years ago is the basis of today's forecast models," says Dr Leslie. "This research will be used in the 21st century."

Advances are also being made with innovative observational platforms. Australia is surrounded by oceans, over which it is difficult to obtain direct observations. Dr Holland is working with the Wackett Centre at RMIT and the Insitu group in the United States on developing a new aircraft to take observations anywhere on the globe. This aircraft is not much larger than a hobbyist model, but is capable of autonomous operation with flights of several days duration over distances of 10,000 km.

Such technology, if proven reliable, will provide an economical method of obtaining these much needed observations. □

ASHLEY CRAWFORD



AUSTRALIAN VIRUS RESEARCH SPREADS

The MacFarlane Burnet Centre is one of the world's leading medical research organisations. Established in 1985 its mission is to establish an internationally competitive biology research institute. Unusual for Australian research centres, the Institute does not simply use laboratory techniques to answer medical questions. It seeks preventive measures and maintains a strong

links with other hospitals collaborating on patient research and new treatments of viral infections.

The centre has had its share of commercial successes, says Professor John Mills, scientific director of the centre. It can claim to have been either partly or wholly responsible for the breakthrough Hepatitis A vaccine and groundbreaking HIV testing agents for which the centre receives international royalties.

"There is considerable concern in Australia about the development of infection technology and becoming a 'clever country'," says Professor Mills. In biomedical research, Aus-

tralia has been extraordinarily successful and "has an importance which is substantially greater than the population of Australia might suggest," he says. "There's no question that the intelligence necessary to make these discoveries is present in Australia." The lapse is that the research is not recognised and supported the way it should be: "The problem is not the component that occurred *prior* to commercialisation, it is in the commercialisation step *per se*." HIV, one of the centre's priorities, has attracted government funding.

The centre has had a major impact in the public health arena, especially overseas. A project under way in Indonesia and Thailand explores the successful production and administration of an inexpensive Hepatitis B vaccine. "These are coun-

tries that have a strong history of Hepatitis B infection and problems such as chronic Hepatitis and liver cancer," says Professor Mills. "If you look at Taiwan, where the best of treatment is available, liver cancer is the commonest form of cancer and one of the major causes of death in people in the '40s and '50s.

"What we've proven is that it is possible to make and deliver Hepatitis B vaccine to the general population economically and efficiently. The results of that pilot study were so encouraging that both the Indonesian and Thai governments have committed themselves to universal Hepatitis B immunisation by 1995 and set in place the administrative structures necessary to implement that."



There's no question that the intelligence necessary to make these discoveries is present in Australia; the problem is not the component that occurred prior to commercialisation, it's in the commercialisation per se.

Following the successes of these projects, Professor Mills sees the involvement of the MacFarlane Burnet Centre to be "largely dropping out of the picture. We have gone in as consultants, worked with them to show them how it can be and helped to develop a way of doing it. They don't really need us any more and it's time for us to go on to other things. But the procedure for Hepatitis B immunisation has been implemented.

"There is only one other country that I know of that has implemented it, Thailand, which was able to institute universal Hepatitis B immunisation reasonably successfully, but they did it in the context of a lot of external assistance and with a standard commercially available vaccine. "Now that's not a glamorous hi-tech fancy super-duper project, but it's important if we want to translate health technology and health care advances into the developing world, and they showed that they could do that very efficiently."

The research at the centre is driven by the scientists, says Professor Mills. "This is not like a company, where a corporate decision is made to go into a particular area. The scientists here follow their noses and decide what they want to pursue." □

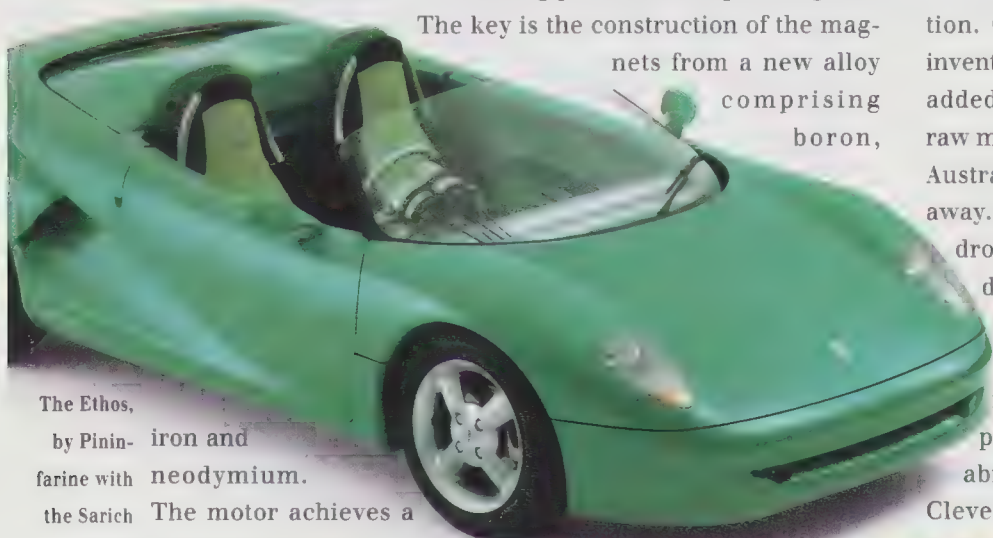
SUSAN OLIVER



FROM TOYS TO ORBITAL TECHNOLOGY

One recent R&D success by the CSIRO is likely to boost exports through its unlikely application to the high end of the global toy market. The Division of Applied Physics in Sydney has nipped out a new electric motor utilising permanent super-magnets.

The key is the construction of the magnets from a new alloy comprising iron and boron,



The Ethos, by Pininfarina with the Sarich Orbital Engine.

neodymium. The motor achieves a remarkable 96 per cent efficiency – 30 per cent higher than existing electric motors – and can reach speeds of 13,000 r.p.m. Efficiency, in this case, does not come cheap, with the neodymium alloy, made by a company called Australian Magnet Technology, costing around \$300 per kilogram: about the same price as silver. However, according to the CSIRO, mass production could reduce the cost by about two-thirds. The main mass market is seen as the manufacture of toy radio-controlled cars, claimed to be a multi-million dollar market.

Cars of a different, and larger, nature entirely are the *raison d'être* for what is certainly Australia's most successful private R&D venture: the two-stroke orbital engine designed by Ralph Sarich's Orbital Engine Corporation in WA. In development for more than 20 years, the radical orbital is now installed in prototype runs of vehicles made by companies as diverse as Ford, General Motors and specialist Italian manufacturer Pininfarina, which uses it as the centrepiece for its ground-breaking,

lightweight, super-efficient Ethos. The second half of 1992 sees the Orbital Engine Corporation investing an extra \$10 million into an accelerated research program that, if successful, could see it swamp the enormous US automotive market by the turn of the century.

In 1998, California will bring in the strictest vehicle emissions regulations in the world, requiring carbon monoxide emissions 95 per cent lower than current US Federal standards and 90 per cent lower than the output of most cars. Orbital are therefore working on developing an Ultra Low Emissions Vehicle (ULEV), designed to exceed the projected regulations. An earlier version was showcased successfully last year by General Motors (US), which used it in its prototypic Ultralite vehicle. A prototype ULEV recently demonstrated almost zero emissions at low mileage under independent testing. Orbital now plan to accelerate refinements to ensure the readings remain as low at the required US test level of 50,000 miles.

The Orbital Engine Corporation stands as a canny success story in determined and profitable Australian R&D. It concentrates on research and analysis – which Australia is good at – then licenses its products rather than itself going into full scale mass production – a capital-intensive and infrastructure-dependent activity more easily achieved by other, larger economies.

Australia, of course, has a long history of research innovation. Only recently, however, have we started to use these inventions, as industry has slowly realised that refined or value-added products and processes make more sense than simple raw material extraction. It is common knowledge that in the '50s Australia invented the black box flight recorder, then threw it away. About the same time we also invented the transistor, but dropped the ball badly when a Canberra sub-committee decided that valves were the communications technology of the future. The list of Australian discoveries that have gone on to make a fortune for international organisations, is huge. However, despite the Australian lack of business prowess displayed by these lost opportunities, the visionary ability that created them suggests that this is indeed the Clever Country. And finally Australia seems to be learning to market that cleverness. □

ANDREW MASTERSON WITH REPORTING BY JANE HILSON



The Sarich Orbital Engine.



THE NEVER-ENDING STORAGE

They're fast-charging, deliver more power for half the cost and don't look anything like your average lead-acid battery – they are vanadium redox cells. Developed at the University of New South Wales (UNSW), they have the potential to radically alter the way we use electricity and make renewable energies economically viable. In fact, talking to the small but committed team of chemical engineers at the university can leave you believing that they have the problems of solar and wind power licked. They also appear confident that, despite working on a shoe-string budget for seven years, they have eclipsed teams with fat funding cheques in Japan and Germany.

"Our battery is one of, if not the, most efficient batteries being developed anywhere in the world," said Associate Professor Maria Skyllas-Kazacos. "What makes it attractive is

that it's very flexible. You can design a battery for a specific application." The batteries store power indefinitely, can be charged as quickly as they are used up, deliver 50 per cent more power for half the cost, and can – in theory at least – be re-used forever.

Skyllas-Kazacos and her team have recorded regular energy efficiencies of 87 per cent with their vanadium cells compared with between 55 and 65 per cent for lead-acid batteries. And vanadium batteries are rechargeable in one-eighth of the time taken for lead-acid cells, the group said.

Their results have attracted attention. Funding has come from the federal Energy Research and Development Corp., the New South Wales Office of Energy, Mount Resources Ltd. and Pacific Power, and an Australian venture capital company has taken a six-month option on the technology to assess its potential for world-wide marketing. Bangkok's Thai Gypsum construction company has ordered a 10 kilowatt (kW) battery stack and wants to build 5,000 houses across Indonesia utilising many more of them, while a large Japanese conglomerate has flown the scientists to Japan to talk about the technology, and is deep in negotiation with the UNSW marketing arm, Unisearch Ltd.

The first commercial applications are around the corner. The Prospect County Council has asked about building a five megawatt facility in the Blue Mountains to operate alongside a conventional lead-acid battery farm. Surplus energy would be stored there on a large scale for release during peak periods, the sort of thing for which conventional lead-acids batteries are the more efficient.

Vanadium is a greyish powder found commonly as an oxide with other ores but in only minute quantities, and is used by industry to toughen steel. The UNSW team of four chemical engineers and six students has found that, mixed with two electrolytic fluids in separate tanks and cycled through membrane cells in a battery casing, vanadium oxide generates electricity, and the energy output can be controlled by the amount of mixture added. A vanadium battery requires 30 litres of electronic fluid for each kilowatt-hour of power needed. The power-giving mixture lasts indefinitely, allowing continuous recycling and endless battery life; only the membranes need replacing.

A study by Japan's Electrochemical Laboratory calculated the cost of applying vanadium batteries to large-scale storage, and found vanadium cells the winners, even when compared against new, experimental batteries. Assuming four-hour storage, vanadium cells could store power for \$264 per kilowatt hour, compared with \$450 for lead-acid batteries, zinc-bromine's \$350 and sodium-sulphur's \$380 dollars per kilowatt hour.

They are also cheaper than mechanical storage, such as

using excess power to hold compressed air or water underground, which is later released to drive turbines during peak demand, the study said. Storing water above ground for turbine driving – such as in a dam – is cheaper at \$225 dollars per kilowatt hour, but most of the world's easy hydroelectric sites have been exploited, making future damming more costly and less of an economic prospect. Even here, vanadium overtakes the field if power is stored for more than eight hours.

The promise of vanadium redox batteries is most obvious in large-scale uses, and could bring power generation down to the home.

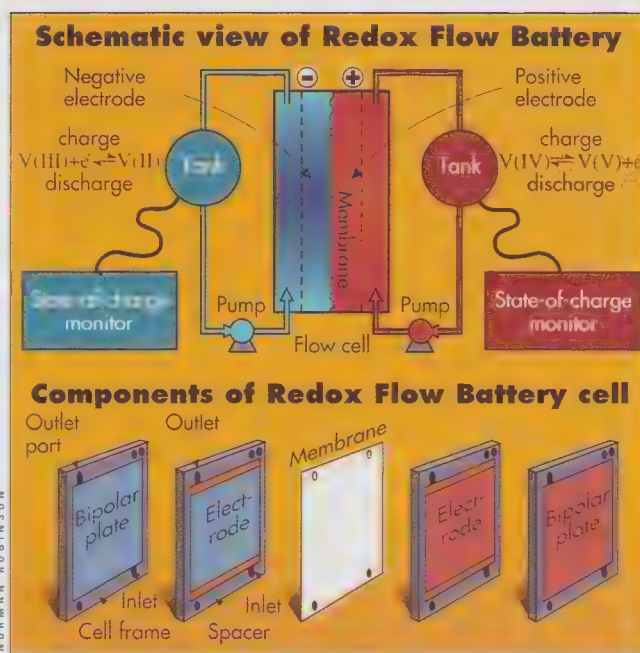
"With the availability of low-cost energy storage, a dramatic shift in energy dependence will be possible in the future," Skyllas-Kazacos said. "The totally self-sufficient house with solar panels on the roof, large battery banks in the basement or garage and an electric vehicle – run on solar rechargeable batteries – could become a reality."

But there is a drawback – vanadium ore, at around \$8 a kilogram, is much more expensive than lead, and more costly to extract. However, its proponents argue that making vanadium redox batteries takes less effort, needs fewer parts and little processing. "Even though the cost of lead is cheap, conventional batteries require days and days of complicated processing, so in the end, they are not so cheap," said chemist and husband Michael Kazacos. "For vanadium batteries, there isn't much processing involved. It will be cheaper than lead-acid batteries to produce, and we're forecasting them to be half the cost of lead-acid for large storage systems."

The environmental attraction of such a battery alone is obvious – it would eliminate many of the disposal problems plaguing today's lead-acid batteries. The researchers say the membranes last between two and 10 years, depending how much you want to spend on the membrane. The UNSW team envisages vanadium battery farms sprouting across major cities, storing the electricity delivered to the area but not used by all homes. During off-peak times, those homes would tap the power at reduced prices.


The cells overcome many of the problems of experimental batteries, such as iron-chromium cells being developed by Japanese companies. Contamination problems have forced iron-chromium cell development by Mitsui in Japan to be abandoned. Then there is the toxicity and corrosiveness of batteries under development, like zinc-bromine cells which present serious environmental problems, and sodium-sulphur batteries which run at high temperatures and are prone to leakage of molten sodium and failure of the whole battery. Meanwhile, research into improving lead-acid cell performance suggests the technology is near zenith and only marginal improvements are possible.

(CONTINUED PAGE 98)



The Redox Flow Battery has the potential to radically alter the way we use electricity.





**War may be hell, but for science
and technology it is definitely the
closest thing to funding heaven.**

A UNIT 444 WITH A NAME TO REMEMBER & MORE

THE INFORMATION

WAR

BY MCKENZIE WARK

War and technology have always been closely related, but never more so than information technology and the Cold War years from 1947 to the fall of the Berlin wall in 1989. Now that the Cold War is officially 'over', and the Pentagon is seeking new military missions and new hi-tech hardware, it is quite possible that military needs won't drive technological change in quite the same way. Still, if we want to imagine what kinds of technological change military needs will force in the future, it may be useful to look to the patterns established in the past. There are basically three levels on which one can look at warfare: the tactical, the strategic and the logistic. At the tactical level, weapons and soldiers are combined with the appropriate drill and training for the purpose of fighting battles. At the strategic level, battles are planned and fought with the purpose of winning wars. At the logistic level, whole societies are organised to produce a continuous flow of soldiers, weapons and material for the purpose of waging war. At all three levels, military needs drive technological change.

1M

Binary thinking used to concentrate on the tactical and strategic issues, but logistical issues have become increasingly important. The Cold War was a logistical war to the extent that it pitted two vast economies against each other. The United States and the Soviet Union were locked in a deadly cycle of technological and industrial competition from the late '40s to the collapse of the Soviet Union. The Cold War was also an Information War. Both sides had to try to combine engineering and scientific knowledge into the weaponry and control systems of the conflict. Both sides also had to gather as much information on the enemy as possible. The war itself was a permanent state of competition on these two fronts. The United States 'won' this conflict in the sense that the Soviet Union broke first. But what price did the American people pay for this victory? The conventional wisdom that the Pentagon's demands were overall a good thing for the economy as a whole is increasingly being challenged.

The most famous technological breakthrough to come out of military necessity is undoubtedly the Manhattan Project, which produced the atomic bombs dropped on Hiroshima and Nagasaki. Less well known but also very important was the MIT radar project. Of the two, radar probably had more effect on the outcome of the war. In any case, what the government of the United States learned out of these two projects was that technological developments were of considerable importance to military superiority.

With the conclusion of the war, a network of institutions was put in place that would retain the services of science and engi-



IBM type 701 computer, 1953.

Industry rapidly became the first and best customer of the fledgeling computer business.

had acquired out of temporary buildings. It was the biggest office building in the world, holding 40 thousand people – but considerably fewer typewriters. Since no-one had considered typewriters would become an essential wartime commodity, not enough were being produced. The Office of War Information had to mount a campaign to get people to donate typewriters to the war effort. The United States government went into the war owning less than a million dollars worth of printing and duplicating equipment. By 1942 it had \$50 million worth. The government archives for the four years of the war were greater than for all the previous years put together.

In other words, the Second World War was an information war as much as anything else. While it matters immensely that the troops be properly trained and armed, and the generals make the right strategic moves, the logistical problems of organising and running a country at war produced unprecedented problems. Problems that were solved by people like Robert McNamara, who would later go on to be secretary of defence under President Kennedy. McNamara was a statistician employed by the army's airforce to help with the nightmare problem of getting its aircraft produced, delivered, crewed, fuelled and repaired all over the world. The army particularly wanted to know how to get its planes from Europe to the Pacific, where they were most needed in 1945. McNamara gathered the information, did the calculations and decided that it was cheaper to build new planes for the Pacific

The conventional wisdom that the

Pentagon's demands were overall a good thing for the economy as a whole is increasingly being challenged.

than to fly the old ones half way round the world. This was one of the first instances of quantitative management techniques, and McNamara would go on to apply them to the Ford motor company. The point is that before giant multinational companies existed, the military was throwing up and solving complex management problems, only to the military they were logistics, not management. Both contemporary military logistics and modern management theory owe a lot to the Pentagon and the most complex war in history.

Not only the theory, but also the

tools of the information age owe a debt to the war effort. While the Pentagon was busy institutionalising modern management techniques in Washington in the '40s, the aerospace industry was busy in California deploying the first generation of computers. Two problems encountered in trying to build high performance aircraft and rockets were to give a tremendous boost to the computer industry. One was that aircraft companies had to employ whole rooms full of engineers, working on long and complicated calculations, to design the new generation aircraft.



neering for the military. Thus in post-war America, a unique development took place: the establishment of a permanent military infrastructure devoted to the development and deployment of ever more sophisticated weapon systems.

It is difficult now to realise how revolutionary this change was. It is worth remembering that the Pentagon itself, the huge office building in Washington that is the symbolic centre of the armed forces of the United States, was very hastily erected in 1942 to get the tens of thousands of new employees the military



As the requirements of
the Pentagon became more
rational and less

The other was that the Pentagon's interest in 'pilotless bombers' was creating a demand for guidance systems that were light, rugged and compact. The early computers were anything but compact, but at companies like Northrop they did begin to replace the small armies of human calculators. The military-driven aerospace industry rapidly became the first and best customer of the fledgling computer business. When IBM shipped its type 701 computers in 1953, 11 out of 19 were for aerospace firms and a further four for military organisations.

The early computers were big, expensive and often not very reliable. It took the integrated circuit or 'silicon chip' to really revolutionise the information industry.

Silicon chips were invented by two men, working independently. Jack Kilby of Texas Instruments and Robert Noyce of Fairchild Semiconductor both came up with a process to make these miniature circuits in 1959. In true American fashion, they spent years suing each other over the patents. Silicon chips are a part of everything these days, from VCRs to washing machines. Yet in the late '50s they were an expensive gadget without a market. The first market for the chips was the airforce, which used them in the guidance systems of Minuteman missiles in 1962.

The post-war Pentagon did not just buy new technologies, it funded their development. An organisation called ARPA, the Advanced Research Projects Administration, was responsible for funding a series of important developments in computing hardware and software design. For example, graphic display interfaces, familiar to every user of a Macintosh computer or the Microsoft program Windows, were an early priority of ARPA. The first computer network, called ARPANET, also arose out of its heavy commitment to computer development. In the post-war years, the Pentagon built up a system of technological warfare, where its competition with the Soviet Union was based

on a peaceable but tense arms race. This Cold War demanded not merely the fastest and sleekest weapons and the most sophisticated logistical back-up,

it also required first rate intelligence. The Minuteman missiles ordered by the Kennedy administration were meant to deter Soviet aggression and were meant to be targeted at all the strategic installations within the Soviet Union. But how was the Pentagon to know where these strategic installations were? The Soviet Union was mostly closed territory. Hence the development of spy planes and spy satellites. The goal, finally achieved in the Keyhole satellites of the '70s, was constant, real-time surveillance of Soviet military activities. This was the cumulative result of several technological developments in rocketry, satellites, radio communications, coding and of course digital imaging.

Every video camera on the market these days has at its heart a device called a CCD, or Charge-coupled device.

Developed in the Bell labs for the Pentagon in 1970, these devices are able to register extremely low levels of light. This is because the original design brief called for a technology able to detect the flare of Soviet missiles from high-orbit satellites. Now the home video enthusiast can video-tape a scene lit by a single candle while the Pentagon watches the tiny traces of missile tests from way out in space.

All of the intelligence imagery gathered by the Keyhole satellites has to be collated and processed, and this is the job of the National Photographic Interpretation Centre (NPIC) in Washington. Originally built in 1961, NPIC is now responsible for digitally storing and analysing millions of satellite reconnaissance images. To do this it uses supercomputers and an extraordinary

its needs corresponded to the
needs of commercial industry,
let alone ordinary people.

array of programs that are capable of comparing images with previous ones of the same area or from different areas but with the same shaped objects. It can also digitally enhance images to bring out information not apparent in the visible spectrum.

In short, the technologies for gathering, storing and analysing visual images that are the next step in commercial computer design already exist in the military sector. Technologies commissioned for the military eventually find their way onto the consumer market. Graphic interface computers, CCD driven video cameras, satellite TV transmissions and modem driven computer networks are just some of the technologies already in

that it is relatively simple to set them up for a new job. All you have to do is load in the program. This means they are very good for small batches of complex, high precision parts, like bits of helicopter gun-ships, for instance. They also do away with skilled machinists. All they require is an engineer to program the machine tool and an unskilled worker to mind the machine.

Both of these features derive from military thinking about logistics. The Pentagon's requirements for very small numbers of fantastically complex machines like satellites, helicopters and missiles mean that standard mass production techniques and economies of scale don't apply. The Pentagon is also all in favour of eliminating potentially insubordinate workers, even if this means more costly manufacturing

techniques. NC tools are actually more expensive to buy and run than the semi-automated tools designed by the Germans, the Japanese and now the Koreans, but have the advantage for truly paranoid managers of eliminating skilled workers from the process. Hence the needs of the military helped shape the production systems as well as the products of the present age.

Mind you, American machine tool companies can no longer compete internationally, and are now dependant on supplying NC tools to firms that make military hardware. There can be costs as well as benefits to placing military needs at the centre of industrial development strategies.

Now that the Cold War is over, perhaps it is time to take stock of both the costs and the benefits of the huge military presence in the economy of the United States. We now know that military demands crippled the old Soviet Union and contributed to its break-up. Do the present economic difficulties in the United States also derive from the military drain on resources and skills? This is a complex question, and the answer is not a simple one. From the '40s to the '60s, there were benefits to having a technological and manufacturing system driven by military demands, but from the '70s to the '90s, the costs became more apparent. The Pentagon acted as a covert industry policy in a land where free market ideologies which prohibit government meddling in the economy prevail. By funding basic research and development, by providing a market for new products and by eliminating the insecurities in high risk hi-tech ventures, the Pentagon got a whole series of electronics and communications technologies off the ground.

However, once the period of basic research on computers, satellites, integrated circuits, charge-coupled devices, graphic user interfaces, numerically controlled machines and many other technologies was completed, the Pentagon's role may have been more of a hindrance. As the requirements of the Pentagon became more refined and baroque, the less its needs corresponded to the needs of commercial industry, let alone ordinary people. The Pentagon's funding of basic developments in computers at MIT and Stanford University in the '50s undoubtedly contributed to American leadership in computer hardware and software that remains to this day. The very specialised computer problems thrown up by President Reagan's Strategic Defence Initiative (SDI) or 'star wars'



thrown up by
President Reagan's

Strategic Defence

Initiative (SDI) or

'star wars' program

were far less likely to

have benefits in the

commercial realm.

everyday use in domestic and commercial communications; likewise the video cameras with built in gyroscopes to prevent wobble. These were originally designed for the airforce, but are now advertised on TV.

Not only the products, but also the production systems have been influenced by military needs. The mass production system for consumer goods arose out of the need for standardised and interchangeable weapon components during the American Civil War

when fire-arms became the first mass produced 'consumer items'. The idea of standardised sizes for clothing and shoes is also of military origin, as is the first mass production of clothing, which were the uniforms made during the Civil War.

More recently, the move to numerically controlled (NC) machine tools in industry received a huge boost from the Pentagon. NC machine tools are programmable tools, where an engineer loads a program into the device and it executes the complex machining instructions to order. These tools are very expensive to make, but have two interesting properties. One is



Graphic display
interfaces, familiar
to every user of a

program, on the other hand, were far less likely to have benefits in the commercial realm. In any case, the electronics, communications and computer industries now have vast consumer markets and commercial research programs, and do not need military markets or research to support them. Indeed, there may be a price to pay for too heavy a concentration on military markets, as the example of the machine tool industry shows.

Another example in the same vein is the development of special materials which are strong light, and very heat resistant. The Pentagon has a special interest in ceramics, plastics and composite materials that have all three properties for use in very high speed aircraft. To this end they are commissioning development and prototype work from a number of small start-up firms in the United States – and from Japanese corporations. The irony here is that the economic benefits may not go to American business but to its Japanese rivals.

It would be quite wrong to suggest that German and Japanese industrial might has benefited from not being involved with military needs. The Nissan company, for example, makes missiles for the Japanese self-defence forces. Its expertise in building strong, light-weight car bodies came in the first place from making fighter aircraft during the war. In any case, American leadership in computers and silicon chips is still largely intact, even if the American motor vehicle and electronics industries have lost heavily to foreign competition. Pentagon assistance to hi-tech, high end communications industries in the '60s is still producing benefits for the American economy 20 years later. In the long run, however, industry policies which aim to produce industrial leadership as the main goal rather than as a side effect of military domination are likely to be more successful.

For the ordinary consumer, there are still some technological refinements which have yet to hit the market. In particular, the convergence of computer and communications technologies which is heralded as the next step for desk-top computers is already a reality in the military domain. Turning these technical developments into saleable products is another matter, however. While developments in special materials will continue to be a military priority rather than a commercial one, there may be

fewer and fewer spin-offs in communications and computers from the Pentagon connection. Cellular phones and satellite positioning devices, both derived in part from the needs of the US army, may be the tail end of an intense period of military development and eventual commercialisation.

In the political environment of the 'New World Order', it is quite possible that the missions of the various branches of the Pentagon might change. The Strategic Air Command (SAC), which controlled the intercontinental ballistic missiles targeted at the Soviet Union, may no longer be the most important wing of the armed service. Interventions such as in Grenada, Panama and Iraq may indicate quite different priorities, as does the naval build-up in the Pacific which has been going on steadily ever since John Lehmann was secretary of the navy under President Reagan. These new priorities may drive quite different technological developments to the big-spending nuclear programs of the air force and SAC.

While we would all like to be able to tap away at our home computers at peace, the fact is that these everyday technologies often have a very strange history. While new developments like virtual reality (VR) are eagerly awaited, it is always worth remembering where these developments come from. In the case of

VR, for example, several decades of Pentagon funding of military simulations laid the foundations for the new generation of commercial VR developments. It is widely assumed, particularly in the computer and communications industries, that better communication is always a good thing. Given that better communication and data retrieval are also the tools of the information war, perhaps we need to be a bit less sanguine about VR, hypermedia, cyberspace and other utopian visions of the technological future that are now commonplace in the media. ■ McKenzie Wark lectures in communications at Macquarie University. His last story for 21•C was on Cyberpunk sub-culture.

Cellular phones
and the satellite
positioning devices
may be the tail end

MONITORING STRATEGIC INFORMATION DURING THE GULF WAR.



of an intense period
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ment and eventual
commercialisation.

The



➤ In 1957 the great English comic-strip artist Frank Hampson envisaged a space station of the future (below) in the adventure comic strip **Dan Dare**. NASA's plans of the '90s are coming close to these '50s visions as with the Nasa scenario (left) being studied in the Space Exploration Initiative, a transportation depot in Mars' orbit.

21•C CELEBRATES THE INTERNATIONAL YEAR OF SPACE

Final



➤ Saturn photographed by Voyager 2 in 1981, from a distance of 21 million kms.

Earthrise as seen from the moon by the Apollo 11 astronauts in July 1969.



Frontier

An astronaut checking that all's well on the bulkhead of the space shuttle 'Discovery' during its 1988 four-day mission. Russian Alexei Leonov made the first spacewalk in March 1965. The first American was Edward White (bottom) who floated for 20 minutes outside 'Gemini 4' in June of that year. ▶

The launching at Cape Canaveral of a Space Shuttle carrying the Hubble space telescope. ▶



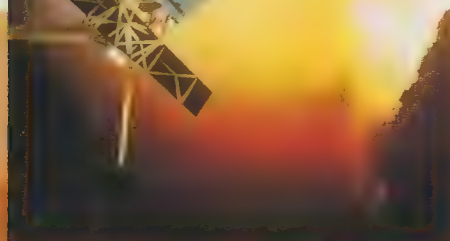
An artist's conception of Space Station 'Freedom', a permanently staffed outpost in lower Earth orbit, being developed by NASA in partnership with the European Space Agency (ESA), Canada and Japan. Freedom will act as a research laboratory in microgravity environment. Later it can serve as an assembly and staging base for the missions contemplated for the 21st century.



In 1977 Voyager 1 and 2 set out on a spectacular reconnaissance mission passing by Jupiter and Saturn. Voyager 1 then headed out beyond the solar system while 2 was directed for a swing past Neptune. Shown here is the south polar cap of Triton, Neptune's largest moon, two-thirds Earth's size. The surface is about -400°F with an amazing assortment of terrains, including a form of ice volcanism that may still be active.

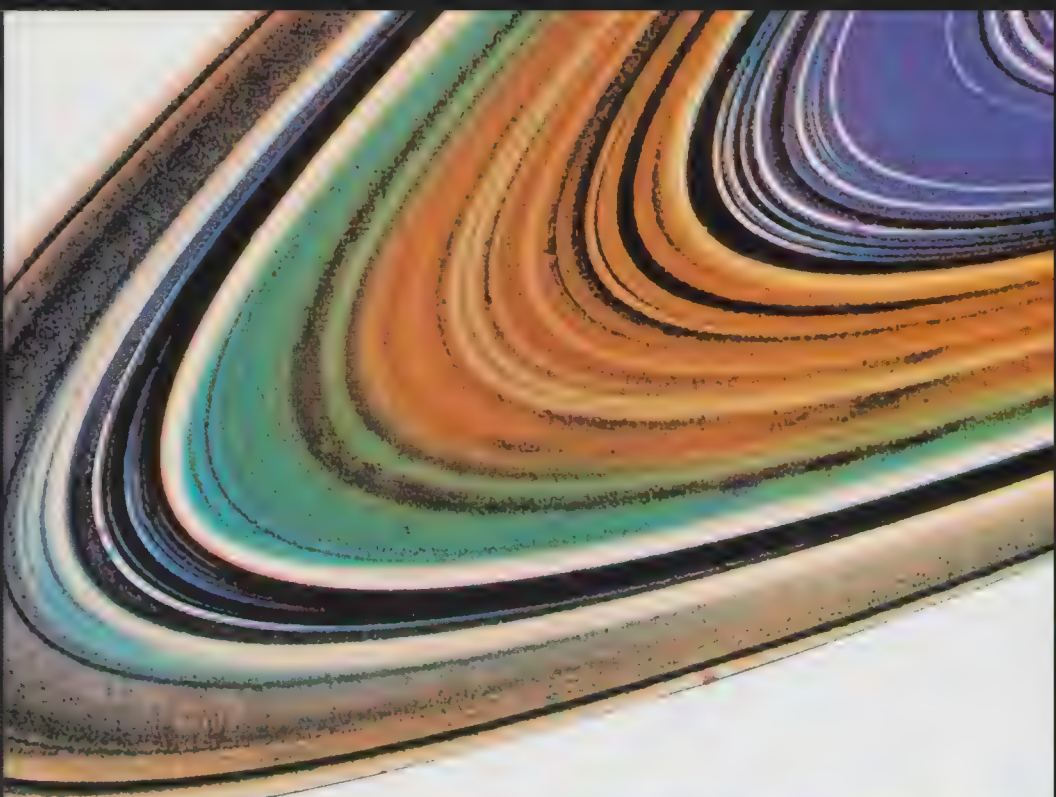


The European ERS-1 satellite, monitoring global environment and climate changes.





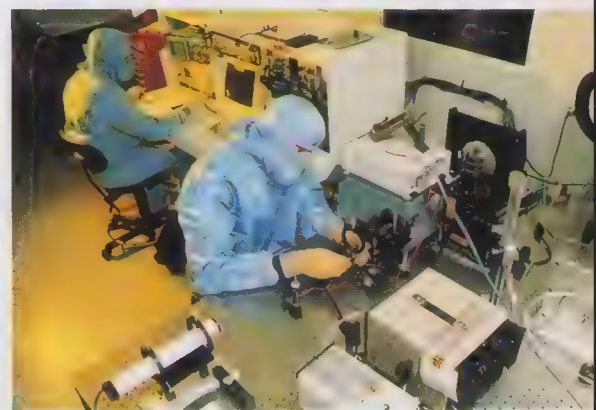
Winter on Mars: Having taken soil samples, the Viking Lander 2's scoop lies next to the trench dug by its sampler arm. Viking 2 was launched from Kennedy Space Center in Florida on September 9, 1975 reaching Mars on August 5, 1976. After separating from its orbiter, Viking Lander 2 touched down in Utopia Planitia one month later. Viking's most widely known experiment searched for signs of living organisms in the Martian soil. None was found, and now most scientists believe life cannot exist on Mars because ultraviolet radiation from the Sun bombards the planet and the soil's corrosive nature would destroy any complex carbon molecules.



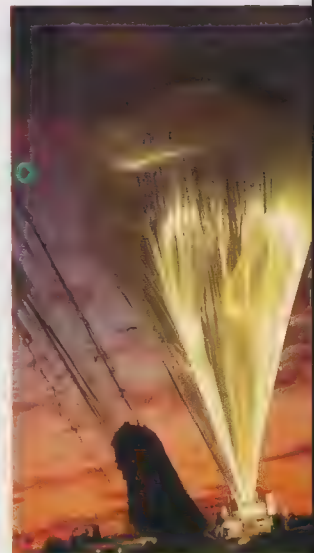
AUSTRALIAN SPACE OFFICE

A photograph of Saturn's rings obtained in August 1981 during the Voyager mission begun four years previously. Taken from a distance of 8.9 million kms, the colour enhancing allows the chemical composition of the rings to be studied more accurately.

A National Aero Space Plane is planned to launch from a runway and shoot straight into orbit. A joint project with the US Department of Defence, NASA is expecting the development of the plane by early next century. It would take off like an ordinary jet and fly into space, or take intercontinental 'hops' at up to 25 times the speed of sound.



Three aspects of Australia's continuing involvement in space exploration. Top: Technicians developing space hardware at the Canberra laboratories of Auspace Limited. Middle: High altitude scientific balloon launched by NASA at Alice Springs, it carries experimental equipment to the fringe of space outside the influence of Earth's atmosphere. Bottom: Deep space network antenna at the Canberra Deep Space Communication Complex – the communications link between spacecraft and mission control.



HAZEL HENDERSON

Raising Hell

BY RICK SLAUGHTER

Hazel Henderson has been infiltrating stockholder meetings since the '60s, criticising companies for waste dumping, pollution and lack of social ethics. Not surprisingly, many corporate giants dismiss her work as overly green and impractical, while environmental groups embrace her as an economic visionary. One thing, however, is certain, Hazel Henderson's impact on economic thought in the US makes her a difficult commentator to ignore.

Henderson is one of the loud generation of voices that joined in the futures debate during the late '60s and early '70s – Robert Jungk, Kenneth Boulding, Marshall McLuhan, Arthur C. Clarke and Fred Pollack among them. Henderson, however, was also an environmental activist alongside such figures as Ralph Nader. Her writings have appeared in major economics journals and newspapers around the world, from *The New York Times* to *The Economist*.

Her work in this area led many economists to be dismissive of her world view, describing it as impractical and unsound. However Henderson's latest book *Paradigms in Progress* has found a receptive audience, arriving after the economic/environment debates raised at the UNCED conference in Rio de Janeiro.

In terms of impact, *Paradigms in Progress* may yet rival Alvin Toffler's *Future Shock*. Indeed, Hazel Henderson begins this interview with just such a comparison, regaling, "it reminds me of what Alvin Toffler told me about what happened to him after *Future Shock*. He thought that if it sold 40,000 copies he would be lucky. And then he began to have this pile of mail, and so he hired first one assistant and then two assistants, and three assistants. They finally got up to six assistants!"

Henderson already has two assistants to help respond to the influx of requests her latest book has caused. "I haven't

decided whether to end up going the (E.F.) Schumacher (author of the bestselling *Small is Beautiful*) route – he told me he *composted* his mail!" she says with a laugh, but adds, "I shouldn't complain. I never thought my stuff would really catch on until long after I was dead."

Henderson's career has a strange genesis. Growing up in a small village in the UK, she lacked any formal economics or university training. "I grew up in a very small village in England, and had a mother who grew all of our food in the garden, and that makes you very aware of the role of ecosystems in terms of providing for human beings. We managed pretty much for everything, locally grown. It was a fishing town, on the Somerset coast. It wasn't too much of a jump, really, to go from there to the planetary level."

But there was something else that spurred Hazel Henderson onto the world stage. "For some reason or other, I felt more attached to the natural world than I did to my fellow humans," she says. "This may be a kind of English phenomenon – the English relate to their horses and their dogs, but not very well to each other! But in a sense I always felt a bit like a Martian on the wrong planet."

Soon after her 21st birthday Henderson moved to the US. "I think Piaget calls it *dépaysement*, where you grow up in one culture and then move to another culture. Forever after you're slightly disconnected, or able to see the culture you're living in in rather sharp relief. I think that was my sharpest tool in looking at the American culture. I figured: If I feel like some kind of extra-terrestrial, I might as well use it as a tool of analysis. And a lot of my books take that point of view – imagine we were arriving on planet Earth and we were approaching and wondering what these life-forms here in this planet are really like.

The birth of her first daughter made Henderson realise

"They've either got a new business card saying that they're an 'environmental economist' or an 'ecological economist'; and the new pitch is: 'If you've got a rainforest somewhere, that you want valued, we're your boys and give us the contract!' A lot of ambulance chasing."



she “had to do something about the environment in New York City, because as a young mother it was just obvious that it was a desperately poor environment to raise a child in”. As a consequence she organised a group called Citizens For Clean Air in 1964. “I plunged into that kind of civic activism. It’s an incredibly rapid learning experience, if you want to find out what makes a culture tick, to throw yourself into something like that.”

Henderson’s work led to her becoming immediately radical. The environmental movement was less than popular at that time and she was inundated with hate mail. “It would say: ‘You’re a communist. Go back to Russia if you don’t like it here!’ and ‘It’s bad for business’. I thought: Well, that’s curious. How is being interested in clean air got anything to do with economics? I realised pretty soon – I was thrown onto radio stations and platforms to

She organised a group called Citizens for Clean Air in 1964... “if you want to find out what makes a culture tick, throw yourself into something like that.”

debate economists, and they were always very patronising. Every time I would be debating some economist from the power company or from Standard Oil or wherever, they would say: ‘Well, she’s a very nice lady’ – because by that time, I’d got about 20,000 members, so I had a bit of political clout. So the only thing they could say was: ‘She’s a very nice lady but she doesn’t understand economics’.”

If anything, the attitude of business inspired Henderson to go further. “That got me into (reading) the textbooks. I thought: I am never going to let an economist do that to me again. So I began reading everything in sight, starting with Robert Heilbroner – that wonderful book, *The Worldly Philosophers* – and from that book I began to realise that their assumptions were questionable.

“Heilbroner’s book is a sort of introductory text and it’s deceptively simple. He goes straight to their value systems and assumptions, and once you have the assumptions laid out clearly, you’re not put off by the fancy math. Or, at least, you are able to interpret the fancy math.

My next radicalising experience was joining up with Ralph Nader in 1968. He had started a campaign to make General Motors responsible, and it was the first broad stockholder campaign to try to round up the proxies and go to the Annual Meeting and raise hell. So I jumped into that, because by that time I had realised that about 35 per cent of New York City’s air pollution, by tonnage, came from General Motors. At the end of that campaign, I wrote an article titled ‘Should business tackle society’s problems?’ I sent it to the *Harvard Business Review* – this was about 1967. I said: ‘I’m not an economist, I’m just simply a new American citizen and an activist, and

this is what I think.’ And I was absolutely floored when they came back and said they were going to publish it.”

It was an article that launched Henderson’s writing career. “I was raising ethical questions about the role of corporations and pollution and social cost. I didn’t realise that the *Review* sends out reprints all over the world.” From that article Henderson was invited to lecture at business schools around the world to talk about business ethics. “I realised that nobody else was doing it, there were no professors of ethics, and there were no ethics courses.”

In 1978 Henderson wrote *Creating Alternative Futures*, a series of essays including her work for the *Harvard Business Review*. “They asked me to do another one called ‘Ecologists versus Economists’ in 1974, which is also in that book. It’s amazing that the debate about economists versus ecologists has not changed one iota since I wrote that damn thing in ’74


– just amazing! Of course we’ve got green economics now. I was at a conference in Washington recently, and there were a lot of economists there, and they are sensing this new market for green economics, and pulling out their undergraduate theses where they may have mentioned Alfred Marshall, or ‘externalities’ a couple of times. They’ve

either got a new business card saying that they’re an ‘environmental economist’ or an ‘ecological economist’; and the new pitch is: ‘If you’ve got a rainforest somewhere that you want valued, we’re your boys and give us the contract!’ A lot of ambulance chasing.”


The battle between ecologists and economists has become a long-running and well documented saga. Henderson in fact subtitled her first book *The end of economics*, a portentous statement which in many respects may prove visionary.

“I certainly haven’t been proved right yet,” she says. “They’re just as strong as ever. The bitterness of the debate is the fact that these are two fundamentally different world-views that probably cannot be reconciled. As I’ve seen the debate over the past 20 years, economists are powerful and in the centre of policy circles in most governments because macro-economic management is the tool used to manage most countries, however inappropriately. The economists try to tell the ecologists: ‘You must learn economics’. And the ecologists say: ‘No, you have to learn ecology’. Each one thinks they have a larger conceptual box the other ought to fit into. My view is that the economics box has a sort of false universality that’s not based in the real world – it’s sort of conceptual, a very tautological thought system. Whereas ecology certainly is a much larger framework.

“For me it was a matter of: the ecologists would eventually win, but the struggle is going to be very bitter, because it’s really about power. It’s the power to name the game. And the economists are the ones that are naming the game. Of course, they are fundamentally the apologists for the entire economic and social structure in most of the G7 OECD

An aerial photograph of New York City at sunset, showing a dense skyline of skyscrapers. The sky is a warm orange and yellow. In the foreground, a cartoon character with a large head, wearing a dark jacket and a hat, is visible on the left side, looking towards the camera. The character appears to be holding a small object in their hand.

"My next radicalising experience was joining up with Ralph Nader in 1968. He had started a campaign to make General Motors responsible... I had realised that about 35 per cent of New York City's air pollution, by tonnage, came from G.M."



"The Global Forum caught on to the idea that it really is one planet and there's no point in continuing to argue about whose end of the boat is sinking."

countries; and now that the eastern European countries have lost out on their version of socialism, the economists appear to be our only philosopher-kings. I think it's going to be short-lived."

The critique argued by French philosopher Michel Foucault and his analysis of power was central to moving on the breakdown of such power structures. "There's no way forward without analysing the power structures. As I tried to do in *The Politics of the Solar Age*, many economists have come along and described the existing social and economic order, and therefore tended to ratify it. Except, of course, for Marx. Nobody was able to shut him up."

This raises the role of citizen action movements beginning at the margins, through radical activism. Decades later governments hear about it and are forced to respond by the force of public opinion. "What's so interesting to me is that most of these corporate early-warning efforts caught on to that a little bit. They realised that they would have to take subscriptions to the Friends of the Earth and Greenpeace newsletters if they wanted to figure out what was happening out there. They generally discounted these movements. A perfect example of that is the socially responsible investment movement. When we started the Calvert Social Investment Fund in 1982 we were laughed off by most of the Wall Streeters; and now this whole movement has burgeoned."

It is a trend that Henderson says she witnessed at the UNCED conference. "The governments of the North and the South were particularly emasculated because they were still caught up in the economic paradigm and they managed to recreate the North-South argument about the new interna-

tional economic order. And the G7 countries lined up and said: 'Well, how are *you* going to pay? How are we going to pay for Agenda 21?' Quite rightly, since the Northern countries had done most of the polluting.

The ambassadors and delegates at the official conference were arguing about who was going to pay to clean up the planet, and all maintaining that we couldn't afford it – which, of course, is part of the faulty economic paradigm. If you had a full-cost pricing system and a different score-card which internalised social and environmental costs, we couldn't afford *not* to do it. While they were all arguing at the main conference, down at the Global Forum the non-governmental organisations of both the northern and the southern countries were getting together and co-operating. They'd caught on to the idea that it really is one planet, and there's no point in continuing to argue about whose end of the boat is sinking."

The transition from old-style industrial societies is proving to be a decidedly painful one. For Henderson the essence of that transition is the shift to a basis on renewable resources, solar energy and calculating sustained yield, and productivity for those resources. "Then, of course, now we have to throw in a lot of Earth restoration, as well, because we blew another 10 years in the 1980s. It will require a value change and that consumption in the North becomes the basic issue of contention, rather than just talking about population growth in the South. It's going to require a tremendous amount of negotiating at all levels, and the NGOs are going to be crucial, because there's going to be a lot of bitterness at the governmental level. But the Third

World will have more parts to play than ever before, because all they have to do is say: 'We're not going to do anything'. And then it's the northern hemisphere's move."

Henderson has spent a lifetime pushing the creative and positive role that business can have in this process. "When I was at Rio I was invited by the Brazilian government to speak at an expo they had called Ecotech '92. This was environmentally sound technologies, with companies from Latin America, Asia, Europe, Japan... and a few companies from the US, but not many. There's a lot of wonderful new start-ups around the Earth restoration, and it seems to me that the shift will move faster as these companies begin to gather steam and, like the solar energy industry, they begin to have lobbyists and form their own trade associations. So as the money which supports most politicians comes less and less from the old dinosaurs that were built on waste and more from these companies built on less entropic forms of production, then we will see politics beginning to move faster.

We have needed a *perestroika* in this country for a long time. I've always talked about the two party system here as the 'Republicrat'. It's really like two football teams owned by the same owner.

Amongst the issues that Henderson has battled, the term 'Information Age' has come in for criticism. She describes it as a "contentless" term. "It's one of those words like 'freedom', it doesn't actually mean anything unless it's qualified. The problem in the world right now is that we're all suffering from information overload. I have a file which gets fatter all the time, called 'The computer snafu' file – wonderful case histories of companies that were put out of business by inappropriate computerisation and cases where decision-makers have been inundated with too much information and their decision-making was made worse. It becomes absolutely necessary for us to examine our value systems and say: 'What are the goals?'

"The 'Information Age' is just sloppy thinking. We have to figure out just what are the principles by which we move to manage this global society. One of the things I suggested in *Creating Alternative Futures* is that there should be a big data bank where we look at all of the value systems of various

"The 'Information Age' is just sloppy thinking... we have to figure out just what are the principles by which we move to manage this global society."

cultures and see which have been the most survival-oriented for the longest, and have managed to fit their population with its ecosystem.

From that we might figure out what are the survival values for human beings. My guess is that it's that unspeakable four-letter word 'love' and sharing and honesty; as well as, of course, understanding that we don't run the planet.

For Henderson the most important message for people and governments is, "The game has changed. The politicians are talking about levelling the global playing-field, and that's a perfectly sensible instinct. But not if they level it according to the economists' lowest common denominator in terms of levelling rainforests and homogenising all world cultures.

My prescription is to level the global playing-field upward by putting an ethical floor under it. That means that most politicians who used to think they could manage their domestic economy, are going to have to spend about 50 per cent of their time doing treaties and agreements to level that

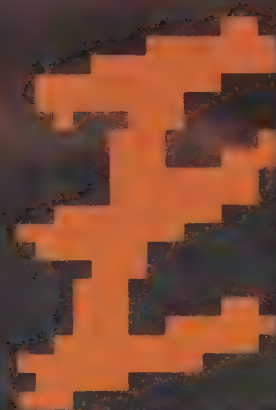


THE 'EXXON VALDEZ' ALASKAN OIL SPILL: CLEAN-UP IN PROCESS.

global playing-field upward. Once we have that ethical floor in place – we're putting together the girders bit by bit, whether it's global warming treaty or whatever – then the most ethical and responsible companies and countries will be able to win this new game."

Henderson's message is inherently optimistic. "At least it's something that people can do, and it's a very easy thing to organise citizens around. I've found that everybody goes for country futures indicators in the NGO community because they can see their particular indicator in there. If you're a health-care worker you can see life expectancy and infant mortality; if you're an environmentalist you can see the environmental indicators; and if you're an educator, you can see the literacy rates and the educational indicators. So it's a natural coalition-builder. And this is the only way we're going to be able to keep politicians accountable for the promises they make." ■

Rick Slaughter's last feature for *21•C* was on Robert Jungk.



XPLODING SEWERS, OIL SPILLS, DEATHS FROM TOXIC GAS, THE ENVIRONMENTAL COSTS ARE UNDENIABLY HORRIFYING. BUT INDUSTRY'S LIABILITIES COULD CAUSE A TURNAROUND WITH AUDITING THAT MIGHT BE THE ENVIRONMENT'S REVENGE. GIB WETTENHALL REPORTS.

🏭 The cost of pollution on business and the community has an ugly and expensive history. IBM spent \$125 million cleaning up one contaminated site in the United States. Toxic cyanide gas escaping from Union Carbide's chemical plant in Bhopal, India, resulted in a death toll of 4,000 and incapacitated over 25,000 people. More recently, a massive sewer explosion in Mexico, led to the jailing for negligence of seven officials from the sewerage authority and the La Nogalera chemical plant owned by Temex oil company. 🏭 At the same time, most attempts to solve these problems have been more watered down than the chemicals flushed into the oceans. Among the more notorious methods are building longer ocean outfalls for waste (Sydney's Bondi is a prime and smelly example), or if it's really nasty you put the waste on a boat bound for somewhere else, preferably as far away as possible. (Read Ben Elton's *Stark* if you want a black-humoured education about the toxic waste ships touring the world searching for somewhere to call home.) 🏭 A more subtle variation has been to insert a waste treatment plant at the 'end of the pipe'. Clearly these methods ignore the old adage that prevention is better than the cure...

The Toxic

A VICTIM OF THE BHOPAL DISASTER WITH HIS EYES BLINDED BY
CYANIDE VAPOURS AND COVERED WITH COTTON TO EASE THE PAIN

Avenge



VICTORIAN ENVIRONMENTAL PROTECTION AUTHORITY (EPA) chairman, Brian Robinson describes the EPA's version on this preventative theme as: "if you don't risk pollution, you won't have to fix pollution". With a Ph.D. in chemistry and a research background into 'cleaner' production, Dr Robinson has long believed in the need for a more holistic and co-operative approach to solving pollution problems at their source.

In the past, environmental regulators and industry have sat in separate bunkers firing abusive salvos at each other from entrenched, fixed positions, says Dr Robinson. Under the old school, the regulators didn't bother going inside industrial plants under the pretext of modifying poor practices. Instead, regulation tinkered with 'end of pipe' engineering solutions, waiting until industrial pollution had fouled air, land or sea before acting – and not a moment sooner. A great deal of time and money has been spent attempting to force compliance with regulations; lawyers once again being the major beneficiaries.

However a new tool to save money and operate more efficiently has been found by industry. Leading companies and statutory authorities world-wide are embracing the concept of the environmental audit. Environmental audits – like financial audits – provide information that can act as the foundation for a corporation's management plan, albeit with an environmental emphasis.

Although environmental audits don't come cheap – a comprehensive audit starts at \$100,000 – the savings can be immense. Since introducing the 3P's program of 'Pollution Prevention Pays' in 1975, the multi-national 3M company estimates it had saved a total of \$800 million by 1991. And in the reduction of waste impacts, they cite a saving of 112,000 tonnes in air pollutant emissions. "Environmental auditing is a way of identifying problems, not just existing, but potential problems," says the EPA's Dr Robinson. "Many companies don't actually know a great deal about what sort of waste streams they have."



BY AGREEING TO UNDERTAKE AN ENVIRONMENTAL AUDIT, A corporation commits itself to considering the pursuit of 'clean' production strategies at all stages of the production process – from raw material to the type of packaging used. Waste minimisation and cleaner production "will dominate the thinking of environmental agencies in the 1990s," claims Dr Robinson.

Over the last three years, the Victorian EPA has pioneered environmental auditing in Australia as "the next step away from end of pipe controls and towards waste minimisation," he said. Environmental audits form part of the new EPA framework being intro-

duced in New South Wales this year, and it is expected that other States and the new national EPA strategy will soon follow suit.

Taking care of business once had nothing to do with caring for the environment. Making money and environmental management were seen as polar opposites. However growing community expectations have meant that green thinking has begun to colour the mainstream. Consumers look for products made by industrial processes which involve less harm to the environment, minimise waste and are recyclable. IBM's chairman in the UK, Sir Anthony Cleaver, who also chairs Business in the Environment, believes one of the most hopeful trends for the future is "the increased awareness of environmental issues, both in business and politics,

coupled with the increasing belief that it is possible to marry economic growth and environmental responsibility".



MORE CYNICAL COMMENTATORS WOULD argue that the heightened 'awareness' is driven by fear. Management has factored the environment into the business equation as the financial costs and legal stakes have spiralled. The Organisation for Economic Co-operation and Development estimates global spending on waste clean-up at \$200 billion annually. In the United States, the Superfund toxic waste treatment program has reached \$153 billion. Attempts to control acid rain in West Germany through reducing sulphur dioxide emissions now cost \$16 billion a year.

Closer to home, the cost of environmental compliance for the chemical industry was up by as much as 80 per cent over the previous year, Dr Robinson estimates. As well, the adoption of Environmental Offences and Penalties acts first in NSW, then Victoria, has significantly

raised the stake for company directors, making them personally liable where pollution is perceived to have resulted from a failure to exercise "due diligence". Under siege from America's Friends of the Earth, the chief of chemical giant Du Pont, Richard Heckert, has issued a powerful challenge to industry: "Our future depends on our credibility with the general public. If we don't establish that, we don't have a future."




INCREASINGLY THIS MESSAGE IS BEING HEARD AND ACTED upon by industry. Overseas, there is a "realisation that society at large will no longer accept the old ways of doing business," reports Steve Prytz, the assistant director of the Australian Manufacturing Council in his study on industry and environment in Europe and North America. "A new test applies to the good corporate citizen. This test has a significant environmental element."

The European Chemical Industry Federation has published guidelines on waste minimisation. The Canadian chemical indus-

More cynical commentators would argue that the heightened 'awareness' is driven by fear. Management has factored the environment into the business equation as the financial costs and legal stakes have spiralled.


try's Responsible Care program has been picked up in Australia, while the Australian Manufacturing Council has committed itself to spreading the word throughout industry on the need for a "new culture" adapting Best Practice Environmental Management.

Overseas, environmental audits of private or public corporations are usually carried out by internal company auditors on a voluntary basis. This is the method being followed in New South Wales. However like the UK, Victoria has brought in a formal accreditation system for auditors. According to Dr Robinson, this ensures that auditors achieve a sufficiently high level of skills and abilities, and are not simply "good salesmen". Since the middle of last year, a dozen environmental auditors have been accredited in Victoria by independent panels drawn from representatives of industry, CSIRO and academia.

 EXTERNALLY ACCREDITING AUDITORS IS THE METHOD preferred by Greenpeace says spokesperson Beth Powell. "Without guarantees of independence and professional accountability, environmental auditors could become creatures of the corporations, engaged mainly in 'green washing' their company's public image."

When environmental audits were first introduced in Victoria, they were predominantly carried out by companies for legislative compliance reasons when ordered to by the EPA. Such narrowly focused audits are being replaced by more comprehensive audits looking at such commonsense prescriptions as the need for good planning, good technology, good housekeeping and a corporate commitment to minimising environmental hazard. Increasingly, corporations are undertaking environmental audits on a voluntary basis.

Ian Coles, a licensed environmental auditor from ICF Pty Ltd., gave some examples of how an audit can act as an important tool in helping companies to identify opportunities for improving their performance. Mr Coles says environmental performance must become as important to management as improving productivity and maintaining harmonious industrial relations. "Some of the most useful insights come from process superintendents... from the guys directly supervising workers, but who are in a position to understand management imperatives," he says.

 OFTEN MAJOR GAINS CAN BE MADE FOR NO CAPITAL COST through what is known in the trade as 'better housekeeping'. Coles gave as an example reversing the 'Tidy Towns' mentality of washing everything down with a high power hose. This practice not only wastes water, but often only spreads waste problems, rather than containing them. Another common housekeeping improvement is to segregate the different types of waste for recycling, instead of throwing them all together, forming a toxic cocktail, for which the company has to pay a high price to dispose.

According to Dr Robinson, "a sustainable future can only be achieved with commitment from the whole community. No individual sector can bring it about alone. Indeed it will only happen through collaboration and co-operation – through a genuine partnership between industry, government and the community at large." ➤



TESTING POLLUTED WATER SAMPLES IN VENICE

■ Melbourne and Sydney Water Boards

Public corporations are increasingly establishing internal environmental audit units. Both Melbourne Water and the Sydney Water Board are, for instance, in the opening phases of an audit. Melbourne Water recently completed the first phase of its audit, identifying key environmental issues and impact areas. Environmental

suspect list to three," said Mr Herington.

The Sydney Water Board has, however, far more intractable sewerage problems than Melbourne Water. Because of Sydney's rock strata base, the city's sewers run close to the surface, causing effluent overflows every time it rains. "Our ultimate aim is to recycle and reclaim as much sewerage sludge as possible," said Lorraine Cairnes, the Board's environment manager.

In the first of the Board's environmental audits, the operation of its 36 sewerage treatment plants is coming under scrutiny, including opportunities for producing renewable energy – through increased methane gas production and the generation of hydro-electric power at some of the larger gravity-fed plants.

Melbourne Water is also experimenting with a new technique for tapping methane gas by trapping it in floats on top of effluent holding lagoons. Both water boards now recycle sewerage sludge as fertiliser. Australian Native Landscapes was recently awarded a contract to compost 50,000 cubic metres of sludge with garden and other organic waste. Composting destroys harmful bacteria in the sludge. "We'd rather sell products than produce waste," Ms Cairnes concluded. □

VOLVO

Urged by headquarters in Sweden, Volvo is one of the first companies in Australia to conduct annual environmental audits. After three such audits, Volvo has made a number of major environmental investments:

■ The use of fully enclosed 'space suits' complete with filtered masks at their fibreglass workshop for the truck and bus plant.

■ With the help of ICI, Volvo developed a water-based metallic paint which contained no harmful solvent content.

■ The elimination by 1993 of the CFC gas, freon, in the making of upholstery and air-conditioning.

■ Waste is separated in all three plants for recycling, even at the canteens.

Volvo CEO, Pehr Gyllenhammar, is not afraid to take a tough stand. Earlier this year, he told a Sydney media conference that cars ought to be banned from all central business districts, as cars moving slowly en masse produce harmful gases. Besides, walking would be faster!

audit manager, Andrew Herington said, "the audit should provide some reassurance for the public and keep our organisation on its toes".

One of the surprises of the audit was to find out what lessees were doing on Melbourne Water land. "We haven't been asking in the past," said Mr Herington.

Another surprise was the discovery of deadly dioxin in moderately high concentrations in sewerage sludge at one of the treatment plants. "Using chemical finger-printing for the very first time, we've reduced the

■ Commercial Polymers (COMPOL)

After pressure from the EPA in the '70s to stop discharging waste into Melbourne's Kororoit Creek, Commercial Polymers (COMPOL), Australia's largest producer of polyethylene, sought to confine its wastes within its own site through a combination of water recycling and disposal to land.

The company's efforts were so successful that by 1986 it was able to stop discharging waste into the creek completely. In a formal ceremony, COMPOL surrendered its discharge licence to the then Victorian environment minister, Jim Kennan.

Seventy per cent of water used is recycled back into COMPOL's cooling tower. After processing as activated sludge, the other 30 per cent is spray irrigated over 37 hectares of land owned by COMPOL. Some 50 sheep graze on the land to "keep the grass down," says Jim Clements, environmental manager at COMPOL for the last 16 years.

In 1986, COMPOL added a winter holding dam for the sludge, building on their rural image by stocking it with silver perch.



FISH BEING CAUGHT IN LAKE CLEMENTS EFFLUENT HOLDING DAM, BY OFFICERS OF DEPT. OF CONSERVATION.

"They're now up to half a kilo in size and perfectly edible," claimed Mr Clements. He estimates that COMPOL saves in waste disposal fees and water charges at least \$200,000 a year. □

Profiles of Power



MINDING OUR OWN BUSINESSES



BIG BUSINESS IS OFTEN PERCEIVED AS A THREAT TO THE little person, a force out-of-control in wreaking environmental and health havoc in the name of profits. Disasters like the Alaskan oil and the Bhopal chemical spills have contributed to these 'popular' images. But if these are today's images, do they truly portray the guiding business principles of the company leaders, and how will business develop in the future? ♦ International-

isation, globalisation – these are the ways today's companies will grow, reach new markets and introduce new ways of doing business in some of the traditional and undeveloped markets. Thinking and acting internationally may not coincide with domestic needs such as managed economic growth, development of a skilled labour market and creation of employment opportunities. ♦ Companies are already forced by shareholders to work for the short-term interest of those investors, and we bemoan the lack of patient capital, to ensure companies are successful over the long haul. If capital is raised overseas by the international companies, it may be unlikely that the interests of those shareholders will coincide with the interests of the national government. Under these scenarios it is most important to understand the values, the guiding principles and the vision of the people behind the brand names, behind the business pages, behind the stock market reports. ♦ SUSAN OLIVER begins this investigation by interviewing three of Australia's major business leaders.

THE BUSINESS OF PACKAGING

IN 1977, STAN WALLIS, at the age of 38, was appointed managing director of APM, Australian Paper Mills, renamed AMCOR Ltd in 1986. (The title APM was retained for the company's pulp and paper business). Since that time, the company that was once in the business of traditional forestry, pulp and paper operations (which generated 57 per cent of sales in 1980 but only 20 per cent in 1992) has entered the high-tech, international arena in containers packaging (cans and plastics) and fibre packaging (corrugated boxes). Not afraid to enter the competitive traditional markets of the USA, UK and Europe, AMCOR has corrugated box businesses in France, Britain and the USA, as well as the growing markets in Southeast Asia. AMCOR's state of the art packaging operations in the UK and France have caught short the local operators with out-dated equipment.

Breaking a few local traditions in a very traditionally defined industry, AMCOR has nudged aside the local suppliers and is building an international company. AMCOR is Australia's fifteenth largest company and among the 10 largest packaging companies worldwide, and this is an improving position.

The company is placing increasing emphasis on off-shore expansion and its 1990-91 Annual Report showed 30 per cent of total sales of \$4.4 billion were generated outside Australia. At a time when companies are reporting very poor trading results, AMCOR reported a 40 per cent jump in interim net profit and Stan Wallis is confident that focus on packaging and international growth will result in continuing success.

As well as global expansion and offshore operations, technology plays a vital part in Stan Wallis' scenario of business effectiveness. A major corrugated packaging research and development facility just north of Melbourne bears testimony to this.

Stan Wallis has committed himself to change in his industry and his company. He chaired the industrial relations task force of the Business Council of Australia for six years from the early 1980s, firmly placing on the national agenda such critical issues for Australia's manufacturing competitiveness as restrictive work practices and enterprise-based agree-

ments. Stan Wallis is satisfied that this early initiative has fundamentally shifted the debate on these issues. He subsequently headed the environmental task force of the Business Council. This involvement, he believes, forced him to look at the environmental issue in a non-parochial way. In an industry where work and environment issues, often also relating to resource security are in open conflict, it is hard to believe Wallis could avoid taking a lead in developing knowledge and understanding of the issues.

Throughout this interview he emphasised that environmental decisions and the participants in environmental discussions need to be well informed. When asked what he saw as the important global issues for the future, Stan Wallis placed environment second to the issues of economic growth and the distribution of the benefits of this growth to achieve improved standards of living for those people in the world who have missed out to date.

"Packaging is fundamental to standards of living and to way of life... and costs of living."

SUSAN OLIVER: *Australia has become extremely polarised in the environmental debate and there's still a very strong 'them' versus 'us' attitude, whether you are talking from the business point of view or the 'green' point of view. That's a very destructive attitude. What can the Business Council and people like you do to get to a point where we are talking in a constructive way?*

STAN WALLIS: The debate in Australia has been more polarised than elsewhere. There are plenty of extremes in Europe and North America but there has been a greater readiness over there for the parties to discuss things in more depth. Better dialogue is emerging in Australia. The Business Council has played its part.

The political motivation in the environmental debate is submerging somewhat and the issues have to be discussed on their merits. There's been a willingness on the part of some of the leaders of the major environmental groups in this country to come and meet industry in sensible forums. If you can get behind some of the public posturing there is probably a lot more common ground about what are the real issues. We may disagree about final outcomes but I think there is cause for more optimism. In Australia the technical and academic communities

STAN



A black and white portrait of a middle-aged man with glasses, wearing a light-colored sweater over a collared shirt and a patterned tie. He is looking directly at the camera with a slight smile. The background is a soft, out-of-focus grey.

'ALLIS

have really failed to play their part in this debate – it's been left to those with genuine motivation on the environmental side but often with inadequate ability to deal with complex issues. There's been responses, particularly in the political sense and from industry, but the academic community has been too often silent. There's a great need for people who are well qualified to form a view and guide us.

How can we make resources decisions and development decisions at a national level if that information is really as patchy and uncertain as it seems?

You are touching on one of the major structural difficulties and limitations in Australia. It's this Federal/State system interposed over 17 million people in a large continent. The process of approval and environmental impact statements and analyses work reasonably well through the States. I don't really mind whether it's in State or Federal hands, but it certainly cannot be a process of duplication and that's what so much of the present pressures are leading to.

A lot of us are very unhappy about the new resources security approach where Federal and State agencies are involved in the decision process, because we are just going to have to go through another layer of approval and it's just going to make the whole process more difficult. It's just another example of the complications and duplications that occur in Australia.

The US, after many years of running environmental protection authorities, is now coming to the conclusion that regulation is not the way, that there are other ways more to do with the production planning stage.

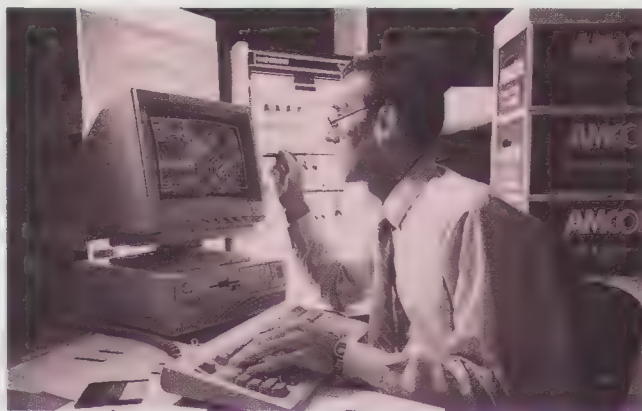
"The answer to the environment has to be tied into economic issues"

There will always have to be a degree of regulation, those minimum standards have to be set in relation to effluents and other important issues. The real answer to the environment has to be tied in with economic issues. The market clearly plays an important part in resolving the major environmental issues. Quite frankly the market place and the pricing mechanisms and the laws of supply and demand have actually done a pretty good job in relation to a lot of environmental issues. Recycling is the classic case.

What so many people will not appreciate is that recycling is about the law of diminishing returns. For every item you put on the recycling hit list there is a different break-even point. There is a point at which if you go too far you will consume more resources, create more environmental impairment in recycling than not recycling and that's a very complex issue. In the final analysis it will be the market place that will be best placed to make that decision rather than by government decree. Around the globe there is this rolling issue about whether issues of waste and recycling are best done by regulation, by deposits, by taxes or are they best left

to the market place and voluntary approaches? I'd have to say that the voluntary approaches and market based systems are quietly winning the day.

The problem with the market response is that it may not be well informed. The packaging for McDonalds hamburgers is an example where plastics packaging was thrown into dispute. Information that we should expect from our technical institutions and universities didn't actually enter in that debate and ultimately the market wasn't well informed. The pressure to paper based packaging was not the best environmental solution, but McDonalds now use paper for all of their



AMCOR: PACKAGING DESIGN ON COMPUTER, R&D CENTRE

packaging requirements. McDonalds is a world-wide business and therefore the environmental implications are not small.

That's a good example of an inadequate process. This is one of the apparent contradictions. Plastic packaging has in many ways a lot of environmental advantage in terms of the energy inputs, the weight issue. With plastic packaging, the environment issue is really about disposability and whether you can find enough holes in the ground to bury the stuff or whether you can get sufficient scale in plastic packaging to justify recycling it because the resins and the structures are so complex that they don't lend themselves readily to recycling without a lot of cost.

If I can give you another example, the organochlorine debate has been run very hard around the world. Greenpeace have done a great job on it but there is really little evidence to say that in the process of producing bleach pulps there is really any significant risk to human health from organochlorines. There are some one or two early examples particularly in Sweden where they had so many pulp mills putting effluent out into a little lake where the Swedes discharge all their effluent and that clearly wasn't a good situation but there is very little technical evidence that says organochlorines in the dilutions that occur in the bleach pulping process cause significant risk to human health. There are far more important risks to human health, or far more important issues to be addressed before that one. But by and large the industry has sort of given up on it and is moving to spend hundreds of millions of dollars, probably billions of dollars to fix up this perceived problem. The tissue people and the nappy based products must respond because they cannot afford the risk on the supermarket shelf. So they just say, well its better to make this investment and make this change. It is interesting to see that the largest

bleach pulp producer in the world, or certainly in North America, has just recently come out and said enough is enough, and has written to all the customers around the world and the market place and said that the investments, the costs of making these changes just do not justify the environmental returns. That's what I mean by the market and the facts eventually coming to the fore so that sensible answers are reached.

I'm concerned that if we wait for the market then it mightn't be a sensible answer.

Australia's position in the environmental debate is different to other countries and we need to recognise that. We don't necessarily need the tightest environmental standards in the world in Australia if we can play a part to solve the problems in other areas of the world where there are more immediate issues. That's not to say we should become the sink for a lot of greenhouse gases but one has to get some balance into these questions.

Packaging is fundamental to standards of living and to way of life. If you travel around the world a critical need is in efficient packaging systems. It is estimated that up to 40 or 50 per cent of the major crops in the underdeveloped countries do not get to the market simply because of inadequate packaging. You could not imagine in modern societies going back to the type of food distribution, grocery marketing that existed 30 or 40 years ago. Packaging not only underpins our lifestyle whether we like it or not – it is an enormous factor in our standards of living and costs of living.

I had dinner one night in Moscow with a senior Russian Minister, and he knew I was from the packaging industry; and he said: "Mr Vallis, you know, one of the things we need more than anything else is a packaging industry". You go into a Russian supermarket – and I always go into supermarkets around the world – and the eggs are on straw, the meat's oozing, the blood's oozing out onto bits of grey cardboard; that's where the differences are starkly apparent.

What do you see, in the next 15 years, as the major opportunities for AMCOR?

Having established this business in Australia we've proceeded to spread internationally, across New Zealand and about nine other countries. We certainly accept the need and recognise the longer term opportunity to have substantial businesses in South East Asia. But we don't have a starry-eyed view of all that. There's a lot of challenges and difficulties in getting businesses that can grow and make returns for your shareholders in South East Asia. We are there, perhaps, more than most companies. But we have been prepared to take on the major markets in North America and in Europe.

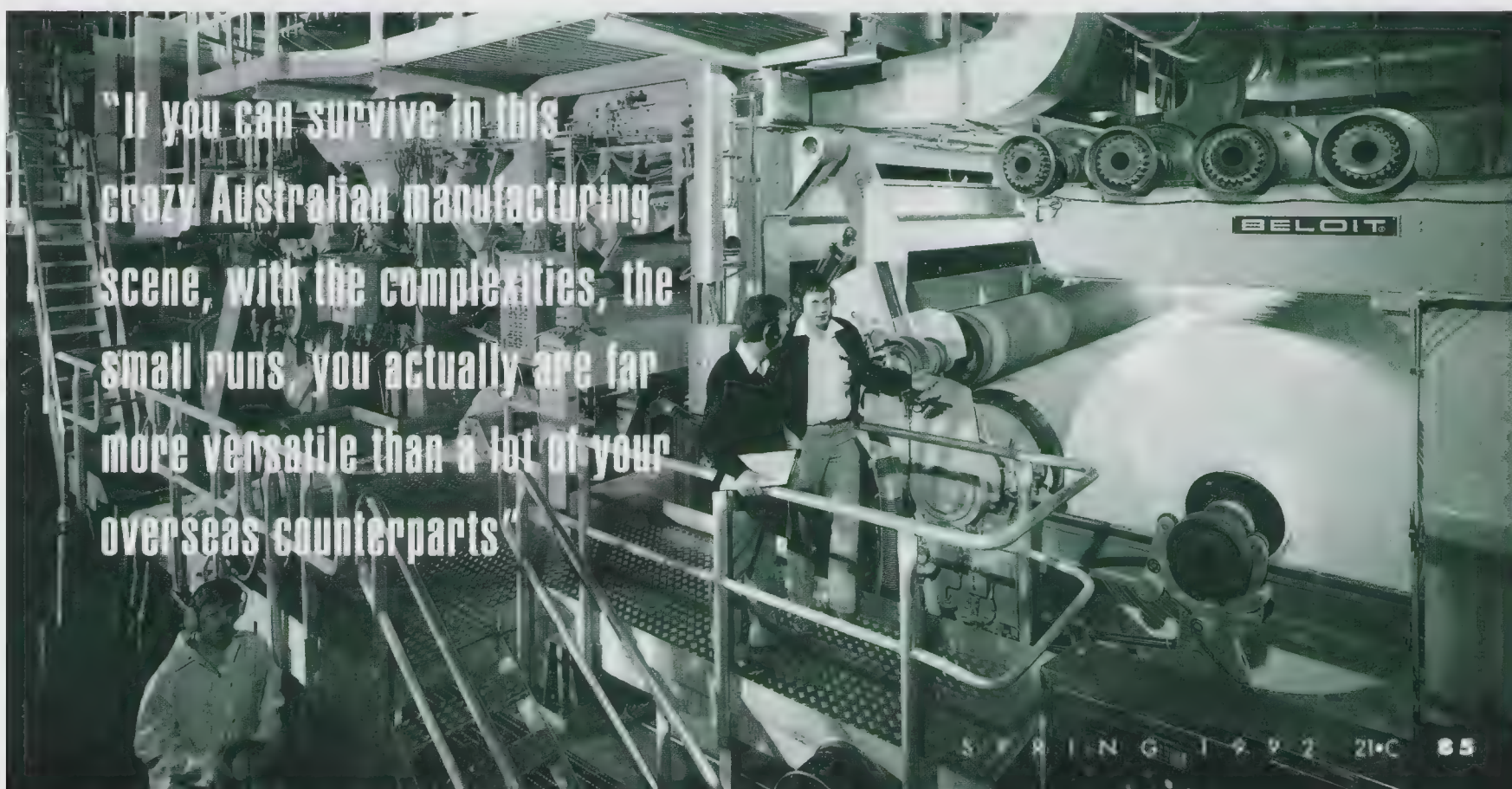
Probably the largest packaging company in the world is a Japanese company, and it sells 90 per cent of its output within Japan. That has been true of the European companies and the American companies. So we are doing something that no other paper or packaging company is doing. The net result is that we're probably the tenth largest packaging company, in global terms, and rising fast.

Europe is a fascinating exercise at the moment, because the traditional sort of segmentation of Europe by political boundaries is changing, and one is starting to see centres of manufacture move up to pan-European manufacture. If Coke or Kelloggs are going to set up one or two or three major manufacture bases in Europe, then we as a company aspiring to a position in the packaging industry have to find a way of connecting with that.

We are actually changing the face of the corrugated box industry in the UK and France by going in with new equipment and catching the existing players very much short-footed, because they have not kept up with the technology. It's interesting an Australian company can do that. It's almost been regarded as a sin that some Australian company should come in and... hop into the Poms in this fashion.

It really does shake the more gloomy descriptions of Australian industry.

(CONTINUED PAGE 95)



OIL ON TROUBLED WATERS

THE OPERATOR of the country's largest oil-producing region in Bass Strait, and Australia's third largest coal miner, Esso Australia is a major economic force in Australia. Since 1982, Esso has spent more than \$700 million on oil exploration, which is about 12 per cent of the industry total and that makes it one of the top two exploration spenders in Australia. This year Esso will spend a further \$60 million in exploration.

Esso Australia's chairman and managing director, John Schubert, wants to make environmental awareness and care intrinsically part of the corporate culture, no doubt responding in part to the emergence of what Peter Robinson of *The Australian Financial Review* describes as "significant domestic emotionalism about the morality of resources development."

"In the space of three decades they (the resource industries) have found themselves skiing at apparently uncontrollable speed down a cyclic slope which has led from resource exploitation being seen as saviour of the nation to being its apocalyptic destroyer."

Last financial year, Esso Australia posted a net profit of \$463 million, contributed \$1,000 million to government revenue and \$228 million to capital oil exploration. It is clearly desirable for Australia to reconcile its development and environmental objectives. In the meantime, John Schubert has done so and is proud of Esso's achievements in environmental care, as well as proud of the fact that \$463 million in net profit more than doubled the after-tax profit of the previous year.

SUSAN OLIVER: *If you look back to the '60s, there are about 10 major projects in the resources sector which established our current standard of living. In the '90s, it's difficult to come up with two or three. How do we reconcile that with a desire for a rising standard of living?*

JOHN SCHUBERT: I'm concerned that without those major resource projects – such as the Bass Strait development, Central Australian oil and gas developments, iron ore in the Pilbara, Bowen Basin coal – being in the pipeline of development in this decade, whether our children are going to see the same rising standard of living. Clearly, over the last two

or three years, the debate over the environment has slowed and even stopped some of the projects that would have gone ahead – and, hopefully, will go ahead.

There needs to be a balance between the economic needs of the community and the environmental needs of the community. That debate's going to be critical over the next 20 or 30 years.

How do you think we're going as a world and as a nation in addressing the contests between "jobs versus the environment" or "economic development versus the environment"?

I don't see it as a contest. If it is a contest then I think we're going to fail in getting the right balance. Clearly there's a debate that has to be had, but I don't think it should be a contest. I think that everyone in Australia is an environmentalist, and I don't think there are any exceptions, whether they be business people, people from government, people

from the bureaucracy, people from all the various levels of life in Australia. I think we all care about the future. We all have children and

we all think that's very important, that we leave them with an excellent heritage. But equally, I think that the vast majority of people also want a rising standard of living for our children.

What is the way forward?

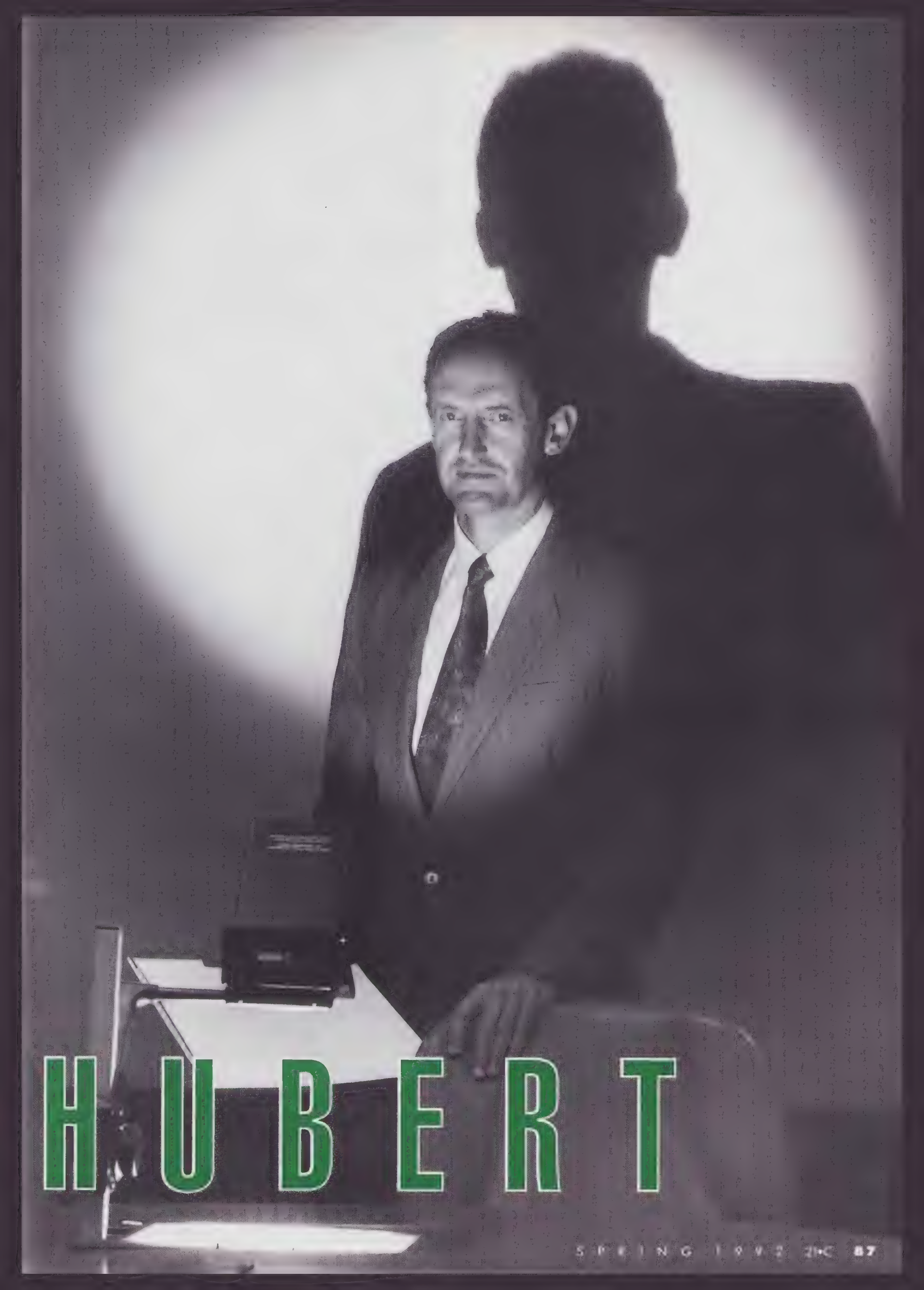
It's important that education programs cover both the economy and the environment. That will solve the problem in the long-term. In the medium-term we have to be a lot more accommodating, and be willing to undertake the research. There are not enough people who are taking the time to get information on both sides of the debate.

The environmental issue is a threat as well as an opportunity for Esso which is in both the petroleum and the coal industry. The threat is that people will use less or use it more efficiently, which in the end means lower demand. Do you feel that the overall growth in the economy and the growth in population is going to sustain a growth in demand?

It depends on which fuel you're talking about. On the coal side, it's something that you build in to forecasts of the volumes that are going to be used, and therefore your opportunity to bring on new mines and sell the output from existing mines. The other end of the spectrum is natural gas, which burns with less greenhouse gases than either coal or liquid petroleum and which Esso is able to supply from its oil operations. I see

"The important issues are business practices and ethics... practices have to be impeccable"

J O H N S C



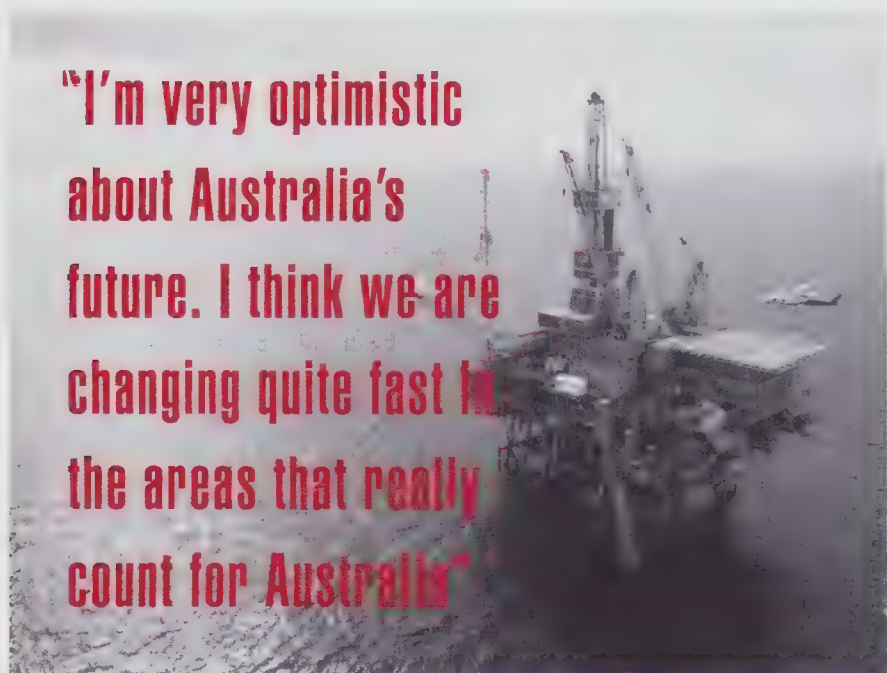
HUBERT

additional markets for gas-fired power generation in Australia. Unfortunately a Resource Rent Tax is imposed on Bass Strait gas. This was poor from the point of view of national energy management, it is also poor because it is the sort of change in the rules which governments impose which hit the resource sector hard.

The Resource Rent Tax at 40 per cent plus company tax on top of that is a savage imposition, and a radical change that really impacts on the sort of stability of the resource sector long-term investment decisions.

How active is Esso in trying to influence the policies of government?

Obviously we try and ensure that our position is heard. Government, in the end, has the responsibility for making these decisions on behalf of the community; but as a member of the business community we think it's clearly our duty and role to point out to government where we think their policies are right and wrong, and why.



But Esso could choose to run a particular agenda about environment or energy management, it could say: let's really buy into this one now, in a public way.

If we think that there's a policy that we disagree with that affects our business, then we will try and be as effective as we can in bringing our position to the fore. Our view has been that we have been able to speak directly to the policy makers, the politicians. They listen. We can speak to both sides of politics in Australia, and we do, regularly. We have that access, as does every other company in Australia.

The important issue for the future you've spoken about is the environment. But what are the important issues that you personally hang on to as things that today's generation as a rule need to be concerned about and take responsibility for?

In business that comes down to business practices and ethics, which, if an organisation wants to stay in business and be successful over a long period of time, their practices have to be impeccable.

Do you think that's just a generational thing? Perhaps the

young people of today don't share those sort of values – perhaps that's why we're seeing a change in the nature of crime and higher incidence of suicide and mental illness among young people as if the way that we had, which was hanging on to some of the traditions, perhaps of religion or family, or society traditions, are not the traditions we're giving our young people; and without those they're cut adrift, in some way.

No, I think the young people coming in to Esso are just as "good" really, in all ways they're better, better trained, have better education than we had. But from an ethical point of view – religious point of view, standards, personal behaviour point of view – I don't think there's any difference.

What are they better trained for? Are they more technically trained?

No, they're not more multi-disciplined. I think that education has improved in 25 or 30 years, educational techniques are better. I think we are smarter in a lot of areas, and one of them is how to teach people. There are aspects of education which I'd like to see improved, but I think it *has* improved in the last 30 years.

Do you feel sometimes the lethargy of Australian society? Do you feel as if you'd like to rattle a few bones?

Yes, I do. I think we all do. I probably feel it most within organisations. And the larger the organisation, the more difficult change is. I think we've learned a lot from this recession; and there are a lot of organisations that are never going to be the same again. I think they're going to be much better. It's hurting a lot of people because a lot of people are losing jobs as a result of it; and so in the short-term it's going to be hard for a lot of people. But in the long-term I think it's going to be good for Australia.

Apart from Bass Strait, you also have interests in the Timor Sea and Central Australia.

We're spending something of the order of \$60 million just this calendar year on exploration, which is a very significant sum of money by anyone's accounting.

In the absence of replacement resource projects, is adding value to Australia's resources the way to provide jobs and export income?

We have to add value to our resources. But before we're going to be able to do that economically, we have to become a lot more efficient, especially our labour markets. But the same also applies to all the areas of micro-economic reform – everything from ports and transport, be it by road or rail or around the coast, or whether it be telecommunications – all of those areas need to become world competitive.

When we do become world competitive in those and in our labour markets, then we'll be able to compete on adding value to our resources. At the moment, it's very difficult. There's a lot of companies who find they can't add as much value as they'd like to in Australia, because of the deadness associated with the critical industrial infrastructure.

Can we draw a parallel between the coal industry, in which Australia is a major world supplier, but which in Australia

"We're spending something of the order of \$60 million just this calendar year on exploration... a very significant sum of money by anyone's accounting."



ESSO: SEISMIC VESSEL 'PACIFIC TITAN' IN BASS STRAIT

has very little vertical integration into say power stations, or cleaner burning technologies, and the petroleum industry which has major world-wide companies engaged in exploration right through to retailing? Is there any reason why our coal industry can't vertically integrate?

The impediment to that in Australia has been that power generation has been the province of State governments and coal is largely used in power generation. Where coal is used for steel manufacture by companies such as BHP, there has been some integration, some commercial co-operation between fuel supplier and user. I think the organisations which will feel the pressure for environmental improvement are the power generation companies. In the past that pressure hasn't been there, but the power companies will feel the pressure now directly from the community and they are going to have to do something about it if they want to meet the community's needs. At the most there will be a partnership between the coal suppliers and the State power authorities providing the right sort of coal for the right sort of technology to be used to burn it. State governments being the large users of coal for power generation in Australia have prevented innovation and integration to date.

Is technology a force for change and competitiveness in Esso Australia's business?

The seismic area is one area in which there have been

significant improvements made in the technology. There have been incremental improvements, but when you add up all those incremental improvements over 20 years, they are very significant. So we can see things underneath the ocean floor that we couldn't see before, and that gives us new things to explore for and new chances of finding more oil and gas, which means more investment, and more oil and gas being produced in Australia and less imported.

There's a number of specific areas where technology has been developed for the fairly difficult conditions in Bass Strait, for example a separation of oil from water via the Vortoil process. This process creates very small 'cyclones'. The oil and water are fed into a cone-shaped vessel and it whizzes around very quickly. The oil leaves the vessel in one direction and the water in the other direction, because of the difference in density between the two of them. That's a very efficient way of separating oil and water which is now being used world-wide, and was prototyped in Australia.

Do you have a watching brief on Australian R&D?

Yes. Monash University has an off shore marine engineering unit which we're very much involved in; CSIRO does some work in various areas. We've done a lot of work with the University of New South Wales and their petroleum engineering department.

I'm very optimistic about Australia's future. I think we are changing quite fast, and I think we're changing in the areas that really count for Australia, such as in response to the need for micro-economic reform. I think micro-economic reform is taking place, it's just much slower than any of us would like, and this is the lethargy you were

talking about before. But if you take a

long-term view, the changes are quite

large. Labour market reform is

under way in Australia. Again,

it's slower than any of us would

like, but it is happening. We

underestimate the advantages

we have with our resource

base and the advantages we

have as a tourist destination,

which we are only just coming

to utilise together with the rural

economy – which has always been

Australia's strength. We need to build

on those. Then I think our manufacturing

industry will recover. And as our micro-economic reforms

and labour market reforms occur, manufacturing industry

will become more competitive.

It is a good sign that there is a move towards benchmarking and world competitiveness, and the fact we talk about that and know that the majority of Australians will know what we're talking about, whereas we couldn't even have talked about it five years ago. With the important environmental overlay that we've clearly got, the quality of life for our kids is going to be pretty good. ■

"We can speak to both sides of politics in Australia and we do regularly"



WHAT'S THE BEEF?

IT APPALS Doug Shears that Australia has so few major companies representing Australian agribusiness. We have national companies like Goodman Fielder Wattie, who are a major player, Pacific Dunlop have their toe in the water, Arnotts is controlled by the Campbells group of the USA. Then there is Shears' ICM and a proliferation of farmer-owned groups and small Australian operators which in Doug Shears' view are going nowhere. "That's a hell of a broad statement," Shears says, "but in the main they are going nowhere. They are working on profit-to-sales ratios of 4 or 5 per cent, they are turning over hundreds of millions of dollars, their technology base is declining, their profits are declining, the consumer perception of their products is declining. Meanwhile 70 per cent of our food industry at the profitable end is controlled offshore and the agenda for the future of those companies will be decided in Tokyo, London and New York. Certainly not in downtown Australia."

Doug Shears' ICM is a wholly-owned family group. ICM has a number of investments in all sorts of areas across the agribusiness chain, and in some of those areas has partners or what Shears describes as "collegiate investors". ICM has attracted some of Australia's biggest institutional investors and some large overseas investors as well.

Most significantly for Australia, ICM is one of our few national companies, and Doug Shears is one of the few business leaders representing Australia's food industry. The company has shown a strong commitment to technology and research and development, addressing both the production, product development and marketing ends of the agribusiness chain. ICM sells beef straight into the Japanese market, beef that is a different product altogether from the one you would typically buy in Australia. It is beef bred specially for the Japanese market; animals of a specific colour, a certain size with a certain feeding regime, butchered and shipped in a container to meet market requirements and deadlines.

Uncle Toby's, recently acquired from ICM by Goodman Fielder Wattie, is a well recognised brand name for such products as Le Snack, the tried and true muesli bar and Roll-

Ups, this last specifically Australian technology. These products have for some years been sold into Asia and Canada.

Shears sees the critical issue for the future as that of global population, and closely associated the issue of distribution of the world's resources. "As the economy moves forward there is an increasing imbalance between the world's rich and poor, an imbalance which, if it continues in the same disproportionate way over the next 10 to 30 years, will cause international chaos." He sees the enormous opportunities technology will provide its owners, but unless the technology is shared it will further increase the delineation between those that have technology, wealth and education and those that have nothing.



SUSAN OLIVER: *It is anomalous that internationally agribusiness is often heavily subsidised but the result can create food surplus, and enormous environmental problems. It seems to me that it's an area where there's the greatest need for reform and change, to achieve efficiency of growing and efficiency and equity in distribution.*

DOUG SHEARS: The issue of reform and change gets back to the basic issue of profit and money. The world revolves around profit and money and nothing changes that. Politics is driven by that, people's needs are driven by that, people's greed is part of all of that and it's almost impossible to change. The only thing you can do is hope to modify, you won't change.

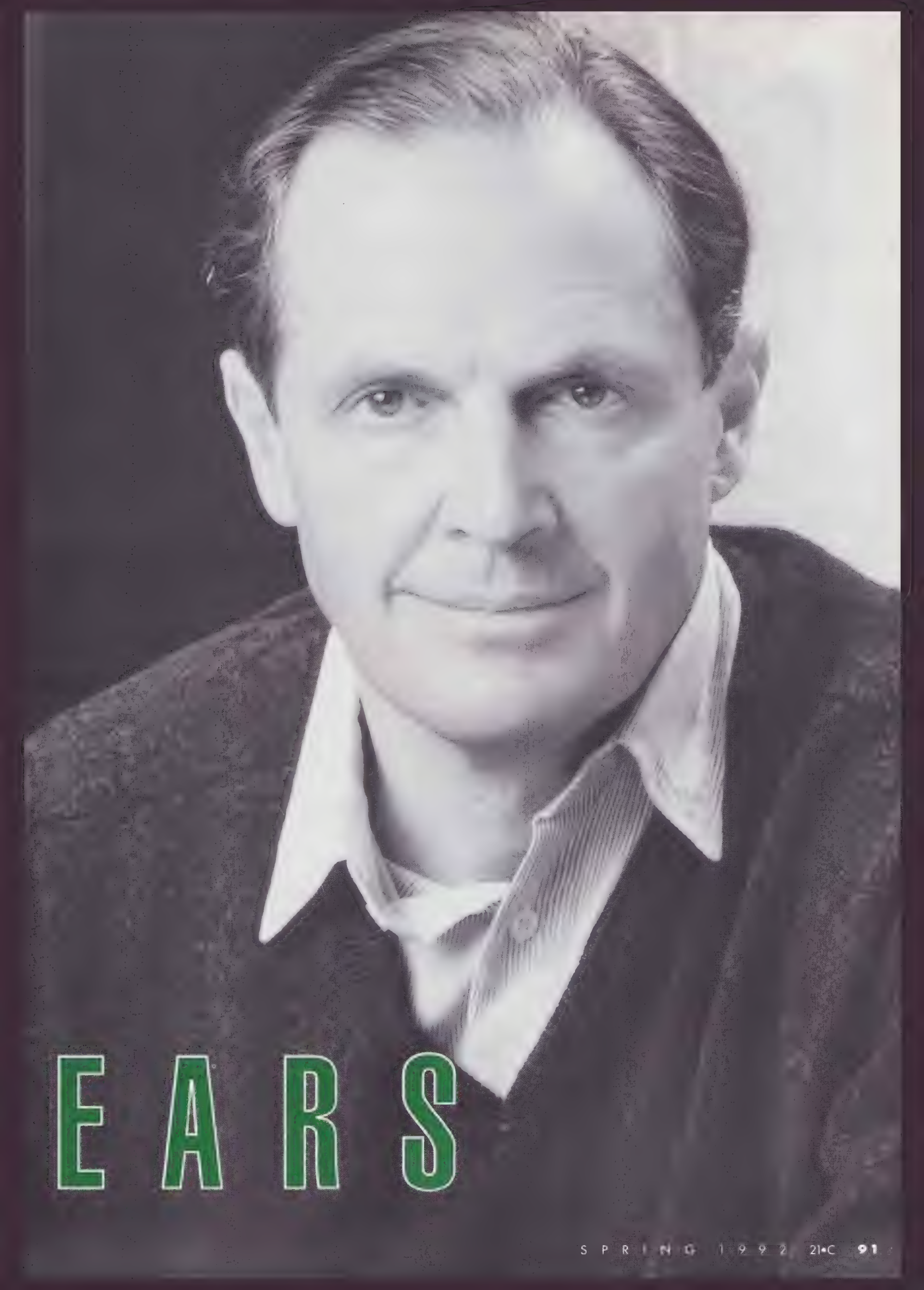
But if the European Commission decides to withdraw or to substantially reduce the level of subsidy to farming couldn't we expect substantial land management benefits to flow?

But if the EC governments are voted out of power because the farmers don't want something because it's too costly for them, then you can bet they'll replace their representatives on the European Commission. All of a sudden they'll take a more realistic economic outlook. So it all gets back to dollars and cents.

In the food industry you can go overboard and have concentrated farming techniques to optimise production in small areas and end up as they have in Holland where a lot of the area is now polluted to such an extent that they can't have the cows pooing on the ground any more. There's going to be an on-going requirement to balance production diffi-

"If Japan
hasn't got an ultimate
plan for Australia, then
my name's not Doug
Shears"

DOUG SHEARS



EARS

culties and the various problems that creates, with the requirement to feed 11 billion people. We are going to need all the genetic engineering and all of the productive capacity that we have in the world in the next 25 years to feed the world's population.

You don't think for those people who are concerned about the salinity issues in Australia and use of marginal land that there's any prospect that we are going to move out of actually farming the land?

I think that maybe we will move out of it as we find the land becomes useless or redundant because of the salinity levels but how are you going to sustain – in a country that is financially strapped at the moment – the argument that we should be paying them to stop farming. We don't have that financial luxury and it gets back to the cost of doing anything and the availability of money.

"We are no more world competitive that a fly in the air"



There are many areas of Australia that shouldn't be farmed because it is just so fragile. An interesting thing they are finding in northern Australia at the moment for instance is they have spent many years developing "drought master" breeds of cattle, in other words cattle that just can withstand drought and dry conditions. They have been very successful and those animals now will live when that country gets very dry as it often does. They won't put on weight but they will be able to sustain a reasonable feeding regime amongst the herbages that remain in the drought and go through an extended period where as years ago they just would fade away and die. Now that's very successful for the animal owners and they have been able to sustain their herds in those very difficult times. But it's devastating those herbages that normally are available to wildlife during that drought period so that at the end of that drought period there is nothing left at all. And they will never come again.

And the land doesn't regenerate as it typically would have in the past. So they are the sort of things that you have got to decide if they are worthwhile. But who's going to stop it, who's going to say don't do it? What political party is going to take that on board, and who's going to pay for it? Is urban Australia going to pay to rescue some of the lands that ought not to be farmed by rural Australia? We're not that enlightened. *Japan heavily subsidises its rural community, particularly rice growers. One imagines this is to satisfy a large and*

influential group of voters, and that basically the rice growing methods employed are not internationally competitive.

Japan is an interesting case because of course they import something like 85 per cent of their food needs. The Japanese are desperately concerned that they may be land-locked without any food. In any sort of international conflict Japan would have to import to ensure its food lines and it could be put over a barrel.

The counter force is the rice farmers. Because there are so many of them, the key political party is concerned about their power base being eroded if the agricultural block should change and support another party. So it doesn't matter what the Americans do in the way of demanding access to the Japanese market, the Japanese are not going to change in the short-term.

But if Australia was to establish a strategic alliance with Japan at a governmental level on issues like guaranteed food supplies then that's the sort of logical association we should be looking for. Not like the much heralded sugar agreement that we very cleverly signed many years ago and then the sugar prices dropped and Japan just said she wasn't going to take our sugar. None of that sort of nonsense should ever be allowed to recur again, it should be on a different basis and should occur in such a way that it is of benefit to Australia and Japan and provide security for both nations. That would help satisfy and delight many Japanese and I think it would help secure Australia's future.

And are we able to supply their needs because we hear that the Japanese buyers find our meat too fatty for Japanese tastes?

Well of course that's the Japanese driving a hard bargain. But that's international trading, so it is to be expected. Australia does need to clean up its act in understanding market preferences. You've got a situation today where Japanese housewives would prefer to buy food from anywhere but

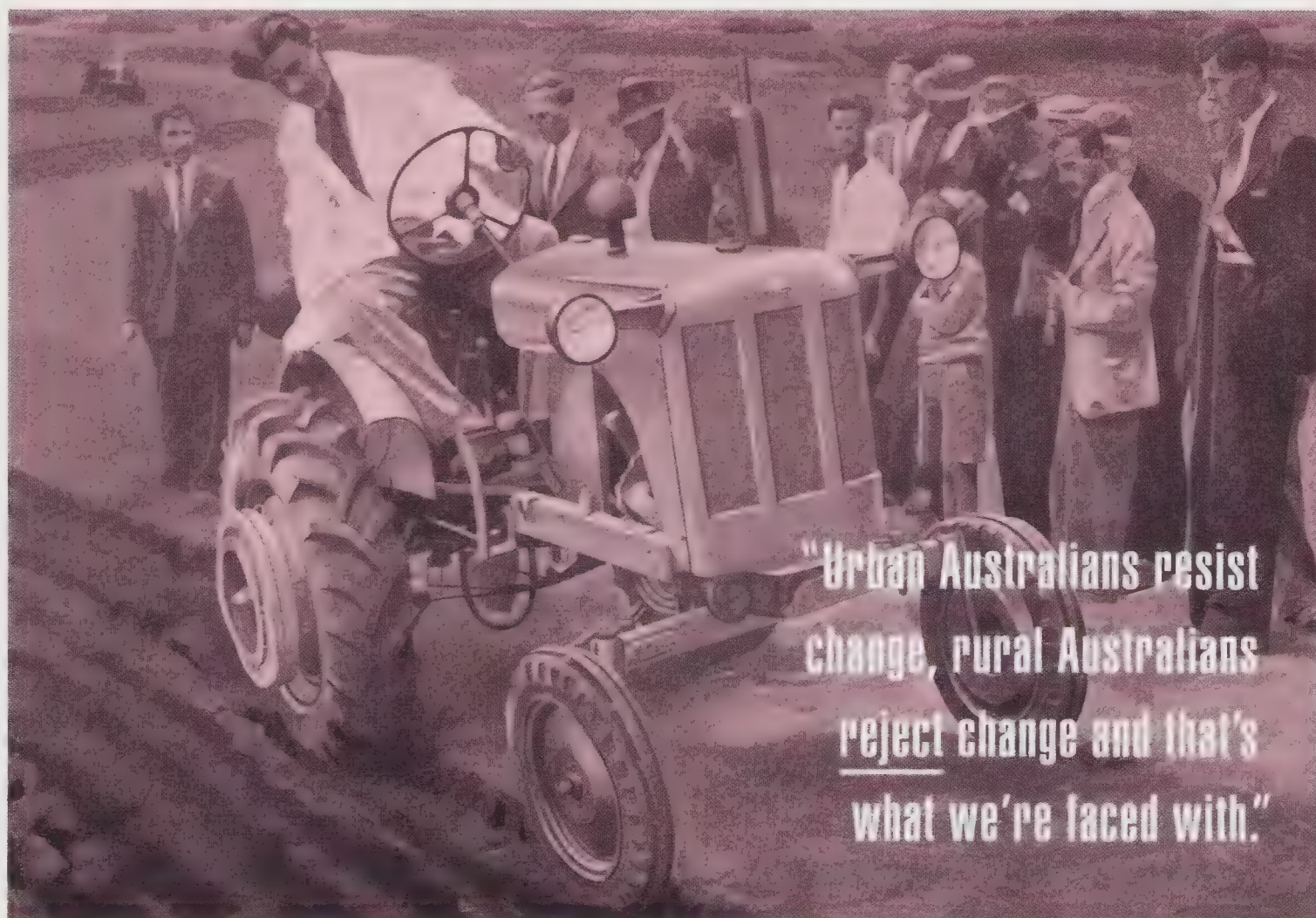
Europe because of the great concern of radiation post-Chernobyl. These housewives understand Australia's cleanliness, clean food and good environment. That is an enormous opportunity for Australia, but who in Australia is taking advantage of that opportunity?

More particularly, I don't think the trading relationships are at the right level between the two countries. They (the relationships) are not developed enough. There should be a greater level of acceptance and understanding of the need of both countries, and greater efforts to secure that relationship for mutual benefit. If Japan hasn't got an ultimate plan for Australia, then my name's not Doug Shears.

It's important that there is an upgrading of the relationship between Australia and Japan. Significant fault

GRAIN SILOS, SOUTH AUSTRALIA





"Urban Australians resist change, rural Australians reject change and that's what we're faced with."

lies on both sides, but if there was a concerted effort to establish mutual groups who worked towards defining what the respective needs of both nations were and towards servicing those needs, it would be a hell of a good start.

What is Japan's future plan for Australia?

I wouldn't have any hesitation in thinking that Japan would see itself economically dominant in Australia over the next 25 years, that Australia just couldn't live without Japan economically, that we could provide a small secure market for them and they could slough off a large percentage of this to Australia. In my opinion that is a situation we could accommodate. There is going to be enormous change over this time – changes like we have never ever seen before – so Australia must try and take a view of what that's going to be and service it. Australia needs to understand that it has to develop into a true multicultural society. Seventeen million 'white Asians' living in a sea of 2 billion cannot continue as we are without any change.

We will only really ever be an appendage to any international trading block. We will never be fully accepted as one of the major partners in Asia and we won't be in the South/North American axis or European alliances. We are out on our own, but that could provide an enormous advantage, providing we recognise it and are proactive.

How do we recognise it and become more proactive?

You need to be much more specific in supplying the consumer needs because the consumers are pretty whimsical in their patterns. You have to focus on their needs, act quickly

and be prepared to change. A lot of corporations are suffering from 'analysis paralysis' and that's just hopeless. You've got to make decisions and you've got to make them fast and accurately.

The Boston Consulting Group, an international business and strategy consulting organisation have just done a job on the Australian food industry and you want to see what they've said – that it's nigh on stuffed – we are no more world competitive than a fly in the air and what do we think we are doing? They are right.

I try to talk positively about Australia because I think there is too much negativity around as there is, but Australian industry has enormous problems and huge competition. We are far from world competitive except in a couple of areas.

Why can't your company gather this up and turn it into something?

I've been brawling with farmer groups for five or six years now. In dairying there is \$1.5 billion worth of processing assets earning around 4 per cent profit on sales and declining, with a reducing market share and with a lowering technology base. Where are we going with dairying? God only knows.

Who are the decision makers?

Bloody farmers on the boards! I've got a Supreme Court case running against a pivotal co-operative, a phosphate co-operative. When I first started looking at them six years ago they had about \$40 million worth of cash on deposit and were burning along. Now they have \$100 million worth of

debt and have come to a stop. They were found by a Supreme Court Judge to be misleading shareholders. I'm saying, "right-oh chaps, you have been found to be misleading and I want you to repay the money and the costs you incurred on behalf of the co-operative, back to the co-operative as individual directors". That's about three or four million dollars which will cause them no end of pain.

One of the reasons I'm pursuing it is to prove a point that these people pervade Australian farmer groups. I suspect they ultimately mean well, but they're all middle-aged and elderly. They all have a narrow focus on business. They all misunderstand a lot of the industries and things that are

ment in that. That's a great move. I think that will happen ultimately in the dairy and wool industries.

Are we getting any pressure, any pull from the government?

Let me remind you governments follow not lead.

I was thinking of Senator John Button when he became Industry Minister and established the car plan and the textiles industry plan, both of which are attempts to co-ordinate national industry development planning to achieve greater competitiveness in these industries.

The Button car plan is probably one of the few visionary things that has ever occurred in this country. What I'm very critical of is there is not a vision for agriculture. There is not a Button plan for agriculture.

So it should be done by industry itself.

Which industry? Represented by who? They are mad people, they don't mean to be, they just are.

Resistant to change?

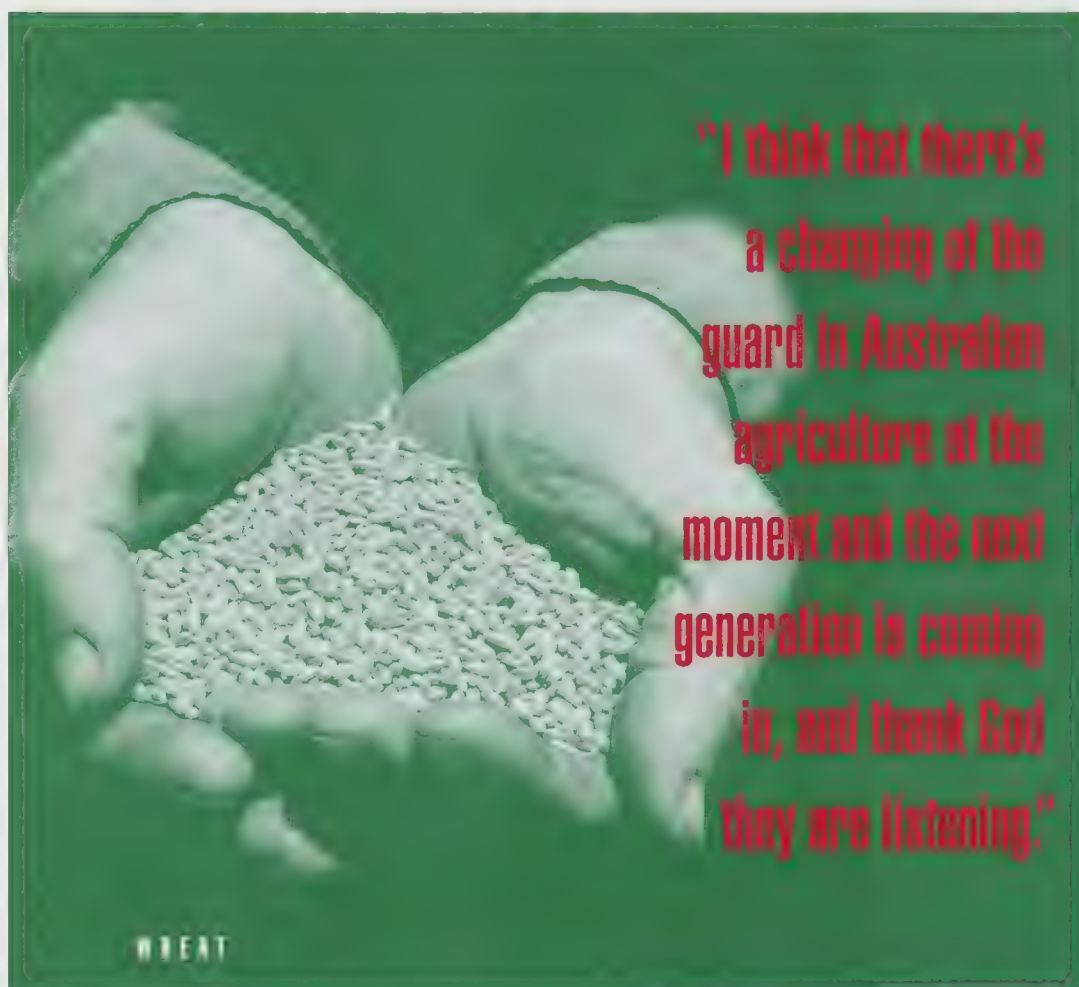
Resistant! We are bureaucratically bound.

Are you happy with what Australian education is providing to the agri-industries?

Absolutely not, we don't think the systems and courses are appropriate. It's antiquated, it's old fashioned, it's what we call 'gum boot' style education. It's got to change, but we're trying to do something about it with the student exchange my company supports to start with, and being critical and hopefully constructive of what's required from courses. It is a whole new game these days when it comes to agriculture. We do agriculture on our PCs. If the PC says we should go and water a paddock, we go and do it. It's totally different and we have great difficulty in finding people who can do it.

Internationally farming has changed dramatically, and it will change more. Corporate farms will never take over from family farms, but for family farms to survive they have to change. I think that there's a changing of the guard in Australian agriculture at the moment and the next generation is coming in and thank God they are listening. People of my age and younger are now taking over from their fathers. Did you know that the average age of the Australian farmer is almost 60?

My vision for the future of Australia is the cleanest and most desirable area in the world to live, with a balance between a modern, multicultural environment with realistic social equity, a small group of Australian domiciled and controlled transnational corporations sited in Australia, say up to 30 dominating various international market segments there-by optimising Australia's comparative advantage. We can do that. We can do that providing we get going and do rather than talk about it. That's all there is to it. ■



happening around them, and they're all saying we don't want change.

Urban Australians *resist* change, rural Australians *reject* change and that's what we're faced with. You think of one and a half billion dollars worth of processing assets earning four per cent per year. It's shocking. It's in the wool industry. In the fruit industry, you've got SPC, Ardmona, Golden Circle, Latona and Berri, all fighting among each other while all these imports are drifting into the country. You've got it in horticulture where Australia's market share is declining, you've got it in the beef industry where it's stabilised at the moment. It's awful. It's not hopeless, if it was hopeless I wouldn't be doing it.

I think that things are moving forward in the wheat area where the Australian Wheat Board is being privatised. There's a situation where they're moving into other types of industries and the Australian farmers will have an invest-

CONTINUED FROM PAGE 85: There are people who want to put Australian management up on the line and take pot-shots. That's good political stuff, and it's good for some people who want to run the argument. There have been plenty of sins in the Australian management area, particularly, in industrial organisation, and we know them in our own organisation. But if you can survive in this crazy Australian manufacturing scene, with the complexities, the small runs, you actually are far more versatile than a lot of your overseas counterparts. I've spent a lot of time with Americans, and a lot of them couldn't survive in the demanding situation that exists in Australia.

How important is Australia to AMCOR?

I'm often asked the question: "Well, where does this overseas expansion all end up?" One needs to bear in mind that we probably created 30 per cent of our business offshore in a matter of 5-6 years, and we've been in existence for 120 years. It is a big issue, because all of the major Australian companies are on the same path, heading off out of Australia. We're doing that because the markets in Australia have not been showing much growth but, more importantly, they probably can't satisfy the aspirations for growth that you need in a large organisation. If you're running a dynamic organisation, you must have growth. You can't run it in a process of contraction.

So you have to ask yourself: "If BHP in 20 years has 20 per cent of its business in Australia and 80 per cent offshore, and Pacific Dunlop and so does AMCOR, what does it all mean?" I think it's irreversible. I don't think it can be changed. There are some real structural problems in managing a business from Australia, where you have 70-80 per cent of your assets, your sales, the foreign exchange issues to deal with, when you have that situation, with a large proportion of your business offshore. But I think we'll have to deal with that. The investment dollar for all those companies, including AMCOR, is increasingly heading offshore.

All of that has implications. I think Australia is our home base. But Australia as a place for large export manufacturing-type investment looks very difficult. The fact is, as you get out into the wide world, there are just so many better places to do it. That's the game that we're all trying to deal with, and that's the issue that's going to have to be addressed in this country, to try and reverse that process.

It's a myth to think that Australia with a growing number of major multi-nationals who have a large percentage of their business offshore can expect that the benefits of that development will start to flow back to the country in the short-term. If the cash is kept offshore, it's reinvested offshore. But maybe we're going to become a bit like Switzerland, somewhere in the next century, where you will have these successful global corporations which will become very important to the Australian economy.

It really does ask the question of what we're going to do in training our young people, and how we're going to offer them meaningful employment.

I think there are only two scenarios. One is that you will see this continual contraction of the added-value manufacturing sector in Australia; and we will have to rely on the agricultural industries, the mining industries, perhaps marginally increased added-value in those sectors; but I don't think it'll be anything spectacular. We will hope that the services sector, tourism, education, hospitality – all of those industries – pick up. There will be more import activity, more people involved in down-stream servicing. That scenario will clearly impact on the skill requirement and the types of job opportunities that are available in this country for young people.

Or we say: We are going to have a manufacturing industry in this country, and we are going to develop some strategic approaches to enable that to happen. The great pity about the debate at the moment, the tragedy of the debate about manufacturing industry in this country is it's too polarised. You've got those who see it as a matter of tariffs; and it's heading back that way at the moment, and that's a protected, highly interventionist approach. And you've got – whatever you want to call them – the level playing fields, as the economic rationalists. I find all that debate terribly unproductive if you understand what's happened in the rest of the world, and how the major industries and major countries deal with it. The problem in Australia is we're driven too much in that debate by the resource people: the agriculturists, the academics in Canberra, and people that really have very little knowledge of the real world.

The second option is to accept that we can focus on industries that have a chance of succeeding. As I say, the tragedy has been that there's been these two extremes, when in fact the answer has to be a pragmatic solution. There's no doubt, if you want to ask me what can make us invest in the paper industry, I'm sure I can come up with some issues. But I've never had a politician come and ask me that question. Because they don't know how to do it. Politicians don't come out and ask you anything. They always want you to go and visit them.

And do you?

No, I don't any more. If I go to Canberra once a year, that's once too many. Whereas I used to go up there all the time. We're getting on with our business. What we've done in a company like AMCOR is that we've tried to analyse our strengths and our weaknesses, and we've chosen a path. I think it is possible for countries to do some similar things.

What is not realised, in relation to Australia, is that with 17 million people on this huge continent, so far from anywhere, you need a unique solution. You cannot get it out of textbooks or the way it's being driven at the moment. The political process doesn't lend itself to any sort of longer term thinking. And whilst I think most of the issues have been well canvassed, by that I mean we know a lot of the problems and the potential solutions, but we just can't get on and do anything about them because either there's too much conflict or people are just plain incompetent. ■

INVESTORS WAKE!

CONTINUED FROM PAGE 59: Skyllas-Kazacos said although some experimental batteries have claimed 85 per cent efficiencies to rival the group's vanadium wonders, these were obtained under special conditions and require slow charging. Vanadium cells, on the other hand, are fast-charged and still produce sustained high efficiencies. The batteries promise to solve one of the biggest problems with solar, wind and other alternative and renewable power systems. Although environmentally friendly compared with coal and oil fired plants, their power input fluctuates as clouds collected during high energy input times – during the day or when winds are blowing – for release during peak demand, or when energy generation fell below that required by a household or area.

One of the exciting prospects vanadium offers is 'instant recharge'. Buses, trucks and fork-lifts could simply exchange their used electrolytic fluid for a recharged solution, and return to work. Meanwhile the spent fluid would be recharged in 20 to 30 minutes – a tenth of the time for lead-acid batteries. And it would never be thrown away, but go on being re-used and re-charged. They would also be ideal for submarines, allowing the electrolytic fluid to fill spare spaces in it hulls and even take the place of some of the ballast, Skyllas-Kazacos said.

Their attractiveness for large-scale power storage comes from the fact that the system's cost per kilowatt hour drops as storage capacity increases. Most of the costs is in the infrastructure surrounding the cells, and once that is built, more banks with larger electrolytic capacities can be added.

Prototype batteries of up to three kW have been built at the UNSW, but this "has just about reached our limit in the lab," said Michael Kazacos. Without a production line, the group does not think it can build the five megawatt facility Prospect wants but believes a 100 kW vanadium facility is possible with some corporate engineering back up.

Although they are widely patented, this may not be enough if the Japanese decide to launch a multi-million dollar assault to catch up with the group's lead. "They've spent lots of money in the last few years trying to match us" said Kazacos. "When we were there, they said they were very interested in working with us, but said they could of course do the job without us," Kazacos saw this as a strategy to entice the UNSW group to agree to a smaller cut of the profit cake or else face the possibility of zero return on their investment if the Japanese spent heavily on matching the group's lead.

The group is keen to commercialise the technology in Australia, but is having trouble just getting quality components made. It has had several local suppliers custom-make conductive plastic electrodes of the type the group makes painfully slowly in the lab, but has yet to find a quality maker. They have imported expensive electrodes from Japan, now to find their hand-made ones better, and are now trialing one last Australian supplier and one Belgium-American firm.

If the group can find local manufacturers willing to take the technology into full scale commercialisation, Australia could capture a large slice of the world's battery market – and very likely overhaul the way the world looks at renewable energy. □

WILSON DA SILVA



THE ANTENNA THINGUMMY

Scientists at the Australian and Overseas Telecommunications Corporation (AOTC) comprise one of several Australian teams working on the practical application of artificial intelligence. Dr

Andrew Jennings, AOTC artificial intelligence chief, describes their construction of artificial neural networks as "building small parts of the brain in the hope that somehow intelligent things will form out of a whole lot of dumb things".

A current project involves the use of neural networks to predict antenna stress. The results say the scientists are startling. AOTC's antennas around the country often need realignment or additional dishes attached which causes weight problems or wind vibration which can lead to the structures toppling over. The team's research determined that factors causing antenna stress are often repeated, meaning that neural networks – which make decisions based on pattern recognition – can make predictions based on past examples. This discovery, now in its trial stages, was a prime example of the serendipity often present in research and development.

"Much to our amazement, the neural network was quite successful in inducing data," said Dr Jennings. "It is not the first use we would have thought of for it. It's fairly practical, but it came as a great shock to us." The stress prediction model is so new that it is still officially known in the labs as "The Antenna Thingummy".

The AOTC team, and others within the complex, are working in the high-end area of Australian R&D. Computer software is one of the fastest growing elements of national R&D. □

ANDREW MASTERSON



WAKE UP AUSTRALIA!

Private sector investment in computer research is increasing at a greater rate than other field of research. According to the June 1992 report of the Joint Committee of Public Accounts (JCPA) on Australian R&D, computer research now amounts to 21 per cent of the private R&D budget, second only to manufacturing technologies.

However, just how seriously the public and private sectors are taking the clever country dictum remains questionable. The report noted that total R&D expenditure in 1988-89 was \$4,187 million, an increase of 34 per cent since 1984-85. That figure represented just 1.23 per cent of the gross domestic product, less than the proportion for 1968-69, claims a report by the Department of Industry, Technology and Commerce (DITAC) earlier this year. The figure ranked Australia sixteenth out of the 19 OECD nations. At the other end of the scale, Switzerland, Japan and Germany all invest more than 2.8 per cent of GDP in R&D.

In 1988-89, 59 per cent of funds for R&D came from government sources, with private business kicking in just 37 per cent (the balance came from non-profit or overseas sources). The level of private investment in research, while increasing, remains cause for concern. The JCPA report noted that only 62 Australian companies have R&D budgets: "In fact, the total spending of all Australian businesses on R&D approximates that of a medium sized international company, like Volvo", it stated.

The criticism echoed the findings of a 1990 report by the Industry Research and Development Board, which sounded a warning about low levels of private R&D: "The presence of multi-nationals and the fact that most Australian companies lack a history in international trade are often raised as common-sense reasons for the differences. But a study of the figures shows that neither is responsible for Australia's lower than expected R&D expenditure. In fact, at present, the multi-nationals in Australia actually spend more on average on R&D than their Australian counterparts." ■



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